AVIATION WEEK

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September 10, 1956 50 cents

New Avionic Devices Meet 500C Challenge

De Havilland Comet III

ALPA Seeks Own Instrument Panel

if it's got to connect ...

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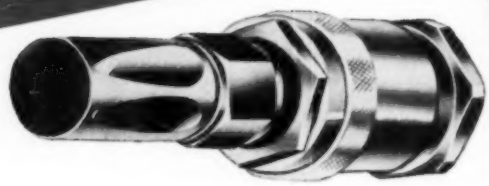
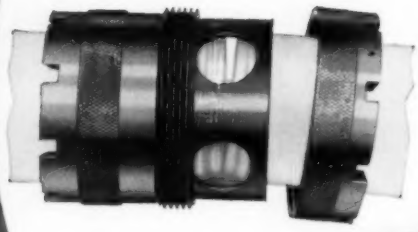
The authority on connectors.
Engineered for reliability.



Connect - O - matic
Trademark

An automatic connector.
PUSH . . . it's connected.



Wig - O - flex
Trademark

Flexible union for connecting rigid tubes.

Inst - O - matic
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Quick Disconnect

Break-away

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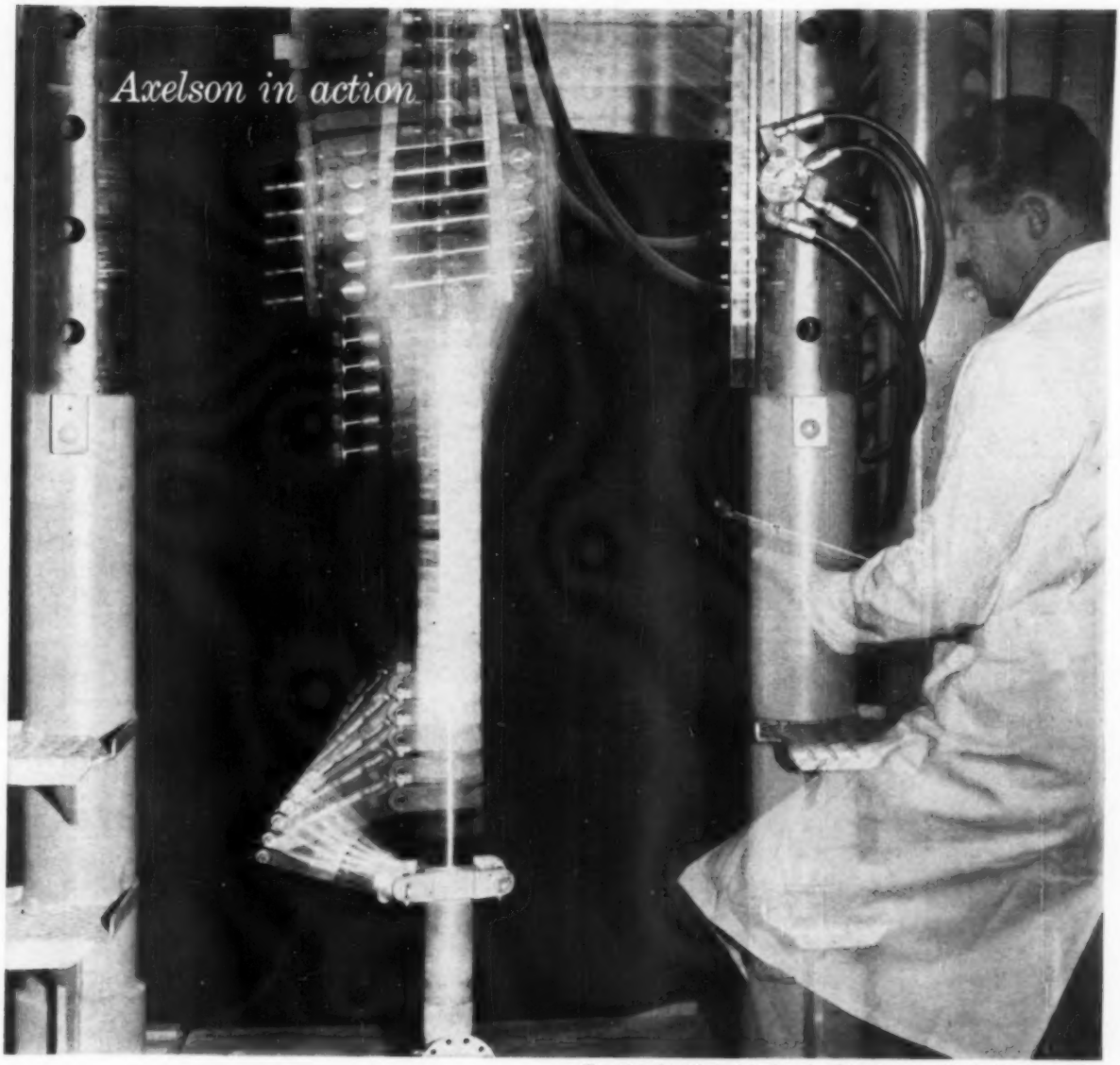

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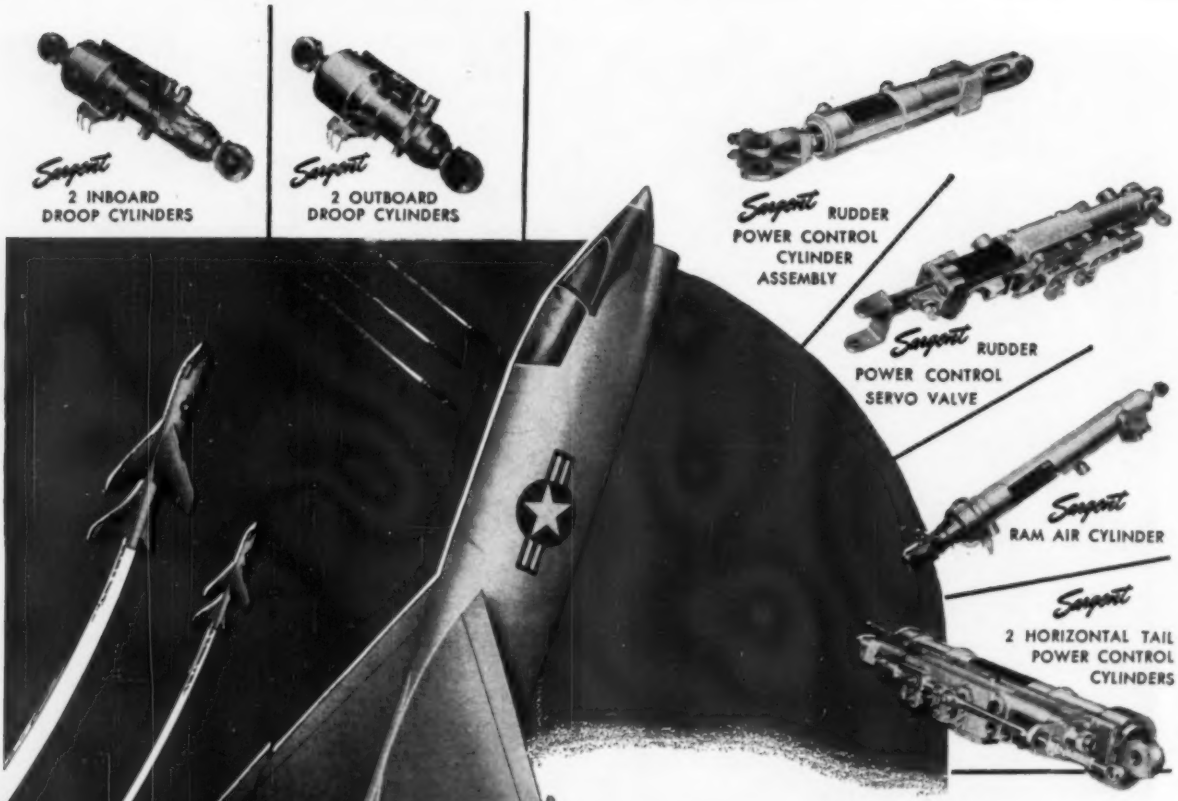

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AVIATION CALENDAR

Sept. 10—Pratt & Whitney, Southwest Airmotive Co., Engine Forum, Melrose Hotel, Dallas, Tex.

Sept. 10-12—1956 Symposium on Information Theory, sponsored by Institute of Radio Engineers, Massachusetts Institute of Technology, Office of Naval Research, Air Research & Development Command, Signal Corps Engineering Laboratories and International Scientific Union, at MIT, Cambridge, Mass.

Sept. 10-14—American Society of Mechanical Engineers, Instrument & Regulators Div. Meeting, Detroit, Mich.

Sept. 14-15—Conference on Communications, Roosevelt Hotel, Cedar Rapids, Iowa.

Sept. 17-21—American Society for Testing Materials, Second Pacific National Meeting and Apparatus Exhibit, Hotel Statler, Los Angeles, Calif.

Sept. 17—International Air Transport Association, 12th annual general meeting, Edinburgh, Scotland.

Sept. 17-21—Eleventh Annual Instrument-Automation Conference & Exhibit, sponsored by the Instrument Society of America, Coliseum, New York, N. Y.

Sept. 17-22—International Congress of Astronautics, sponsored by the International Astronautic Federation, Rome, Italy.

Sept. 18-20—Twenty-fourth USAF-Aircraft Industry Flying Safety Conference, sponsored by USAF Flight Safety Research, Santa Barbara, Calif.

Sept. 24-26—American Rocket Society, fall meeting, Hotel Statler, Buffalo, N. Y.

Sept. 24-28—1956 Trade Fair of the Atomic Industry, Navy Pier, Chicago, Ill.

Sept. 27-28—Fourth Michigan Aeronautics Conference, sponsored by Michigan Association of Airport Managers, Manistee, Mich.

Oct. 1-3—12th Annual National Electronics Conference, sponsored by American Institute of Electrical Engineers, Institute of Radio Engineers, Illinois Institute of Technology and Illinois and Northwestern Universities, Hotel Sherman, Chicago, Ill.

Oct. 3-5—1956 National Airports Conference, University of Oklahoma, Norman, Okla.

AVIATION WEEK • SEPTEMBER 10, 1956
Vol. 65, No. 11

Published weekly with an additional issue in December by the McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices: 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A. Gerardi, Executive Vice President and Treasurer; Hugh J. Kelly, Executive Vice President; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; J. E. Blackburn, Jr., Vice President and Circulation Director.

Subscription: Address correspondence to AVIATION WEEK—Subscription Service, 99-129 North Broadway, Albany 1, N. Y. or 330 West 42nd St., New York 36, N. Y. Allow 10 days for change of address.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation. Position and company connection must be indicated on subscription orders.

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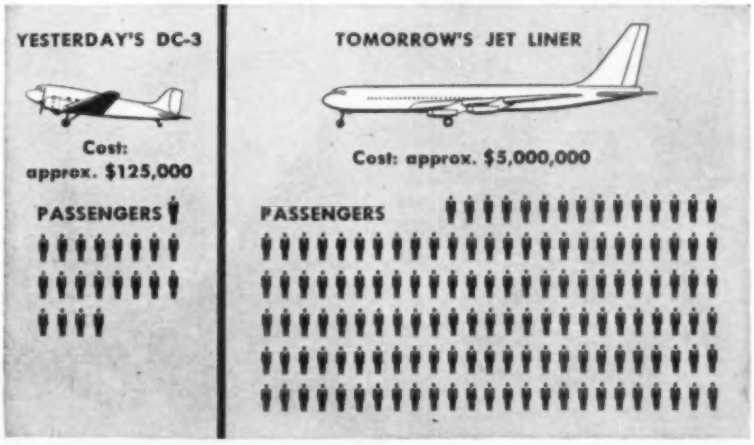

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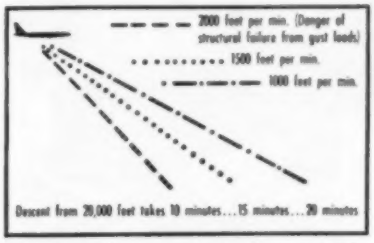
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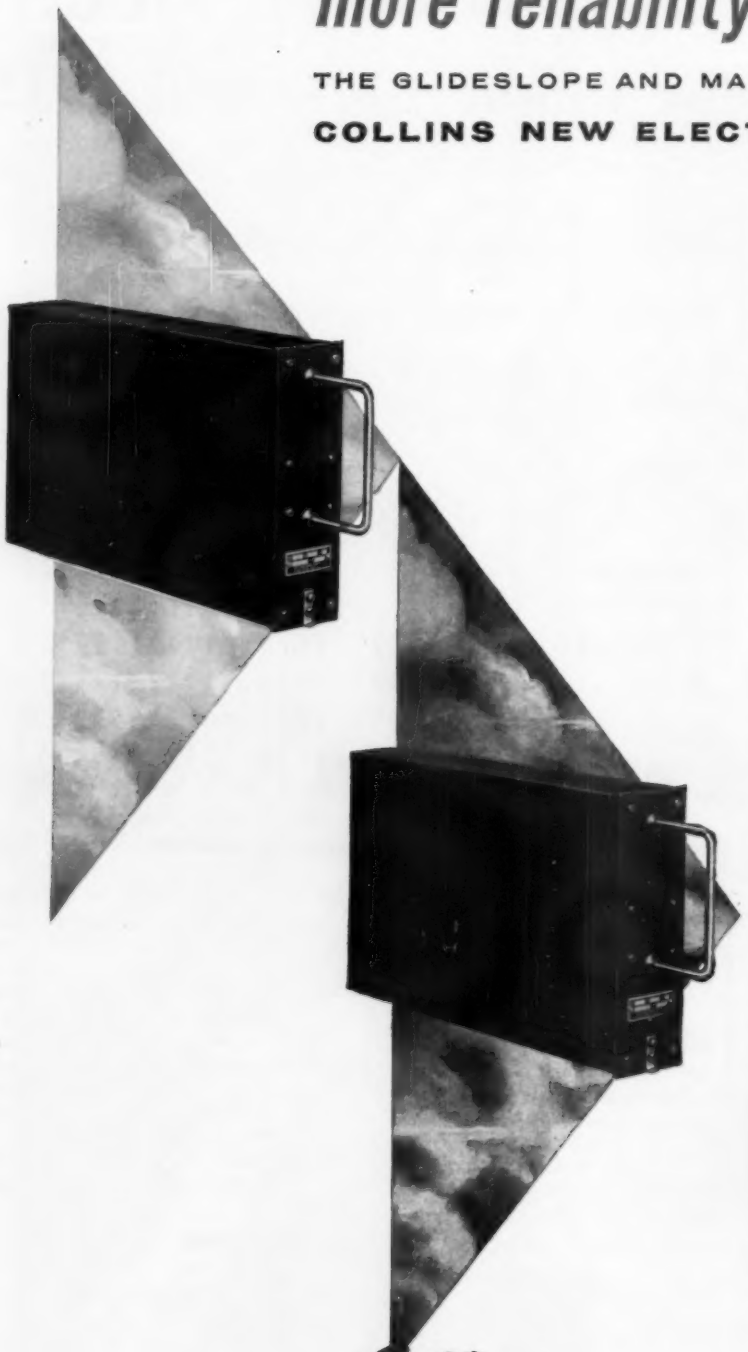

Necessary for any airline's operations, this pair of "Airline Standards" are now much lighter and smaller; compatibly furnish all glideslope and marker information—accurate and reliable. Teamed with Collins 37X-1 Marker and 37P-2 Glideslope Antennas, they make an efficient package and along with the complete Collins New Electronic System increase the operational services of your aircraft.

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Compact and weighing slightly over 6 pounds, the 51V-3 permits selection of any of the 20 glideslope channels. Modularized, available with AC/DC or DC power supplies; spurious response 60 db or more down. Specifications are higher than those in ARINC Characteristic 519 and it is contained in a short ¼ ATR case.

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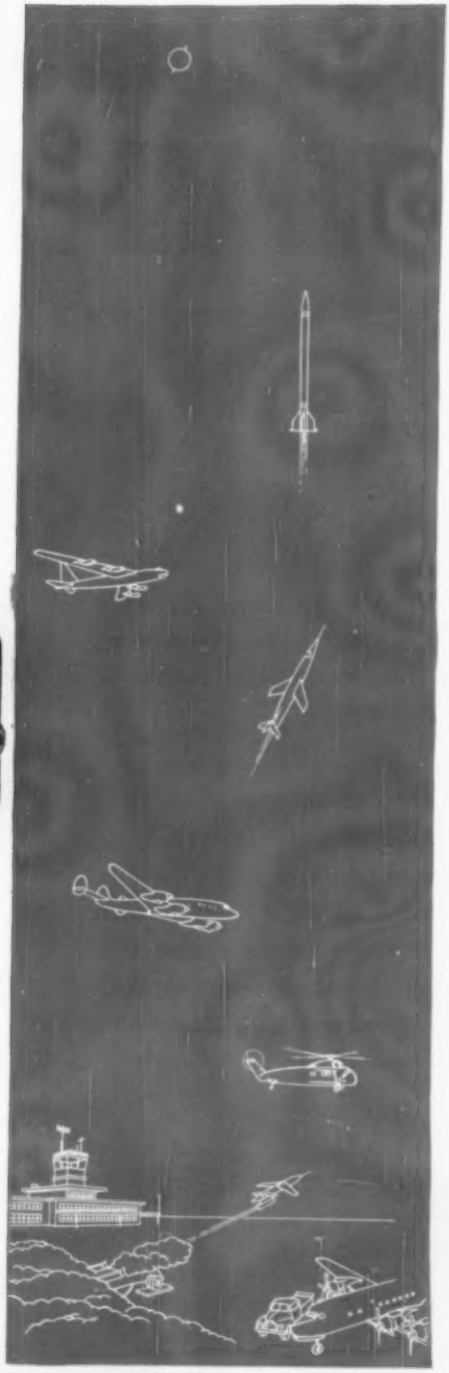

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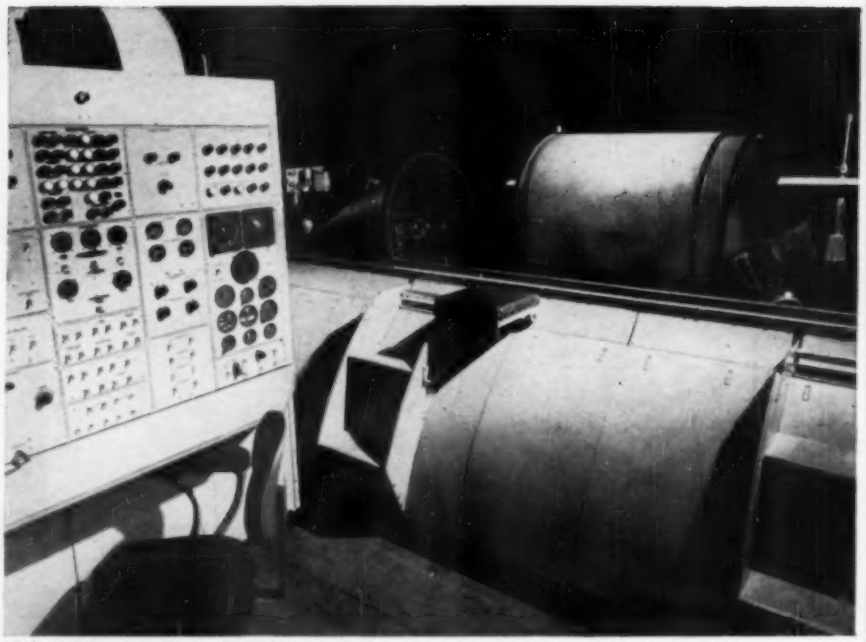

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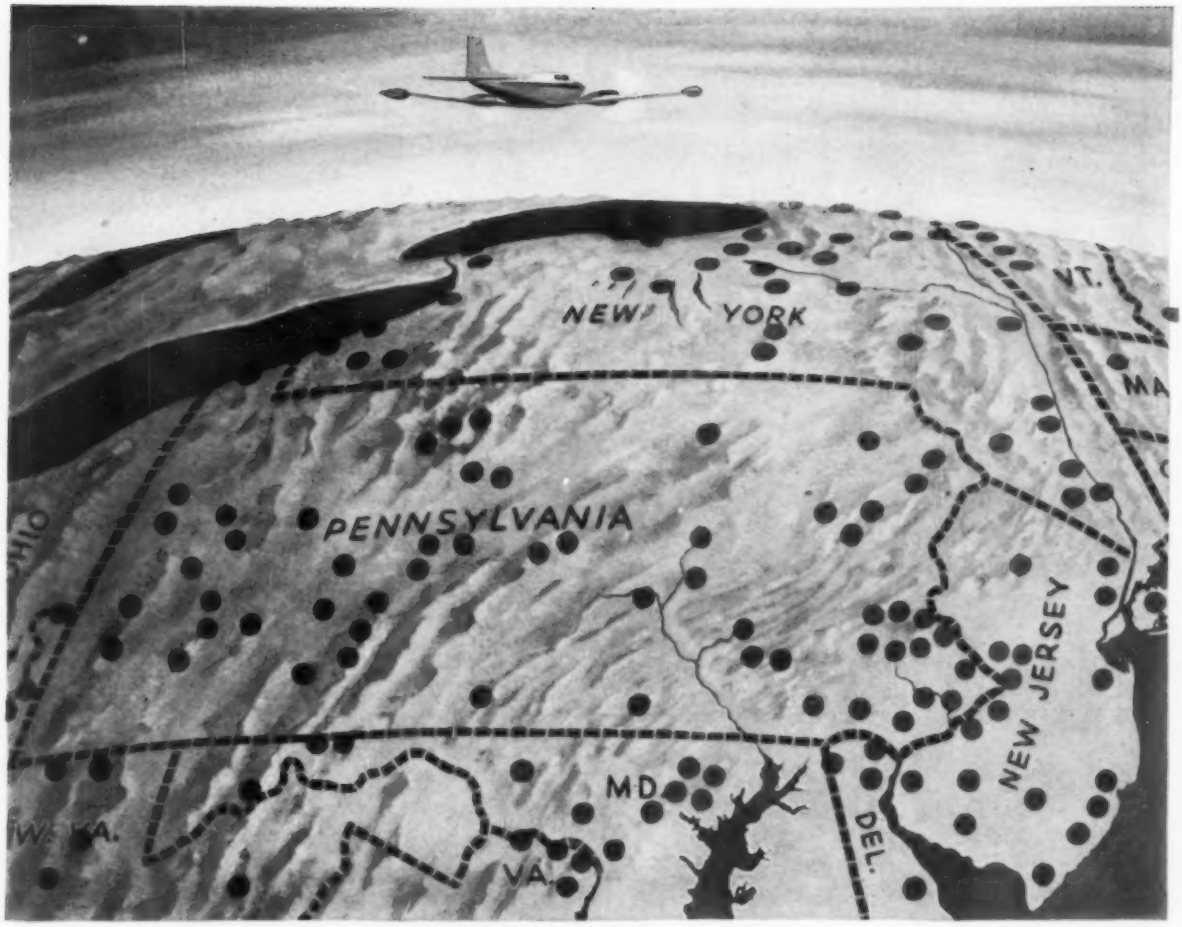

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Top photo shows missile tank constructed of two forged and machined end caps and center section of tubing. Middle photo shows assembled tank. The *Uniwelds* are located in the approximate center of the bright machined bands. Bottom photo shows a tank that has been pressured to bursting with 2½ times normal operating pressure. Note that the split crosses both weld planes with no tendency to divert and follow the weld—graphic proof of 100% parent metal weld strength.

MISSILE TANKS *called for Pioneering, too!*

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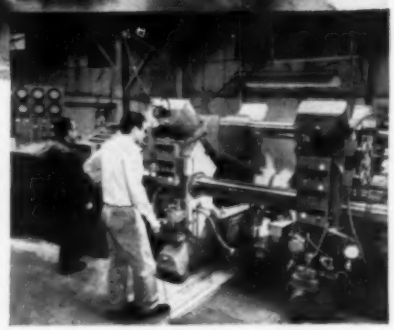
PROVIDE FULL STRENGTH UTILIZATION IN HEAVY WALL PRESSURE VESSELS

Missile components, like the overall Missile System, have demanded that their designers and engineers pioneer with fresh thinking and new ideas in order to keep abreast of modern guided missile research and development. A case in point is MENASCO'S design and production of air tanks for the Nike missile featuring MENASCO'S now-famous *Uniweld* process, an exclusive method of pressure welding.

The twelve-inch diameter welds in the Nike tank fuse in two operations approximately 34 square inches of alloy steel. Because the *Uniweld* maintains parent metal strength, no increase in local wall thickness is needed and the tank becomes virtually a one-piece vessel.

Thus, MENASCO'S pioneering work in *Uniwelding* of missile tanks has opened entire new fields of pressure vessel applications where high strength welds make the difference.



One of MENASCO'S *Uniweld* machines in operation. This exclusive MENASCO process is gaining wide acceptance in the aircraft and missile fields.

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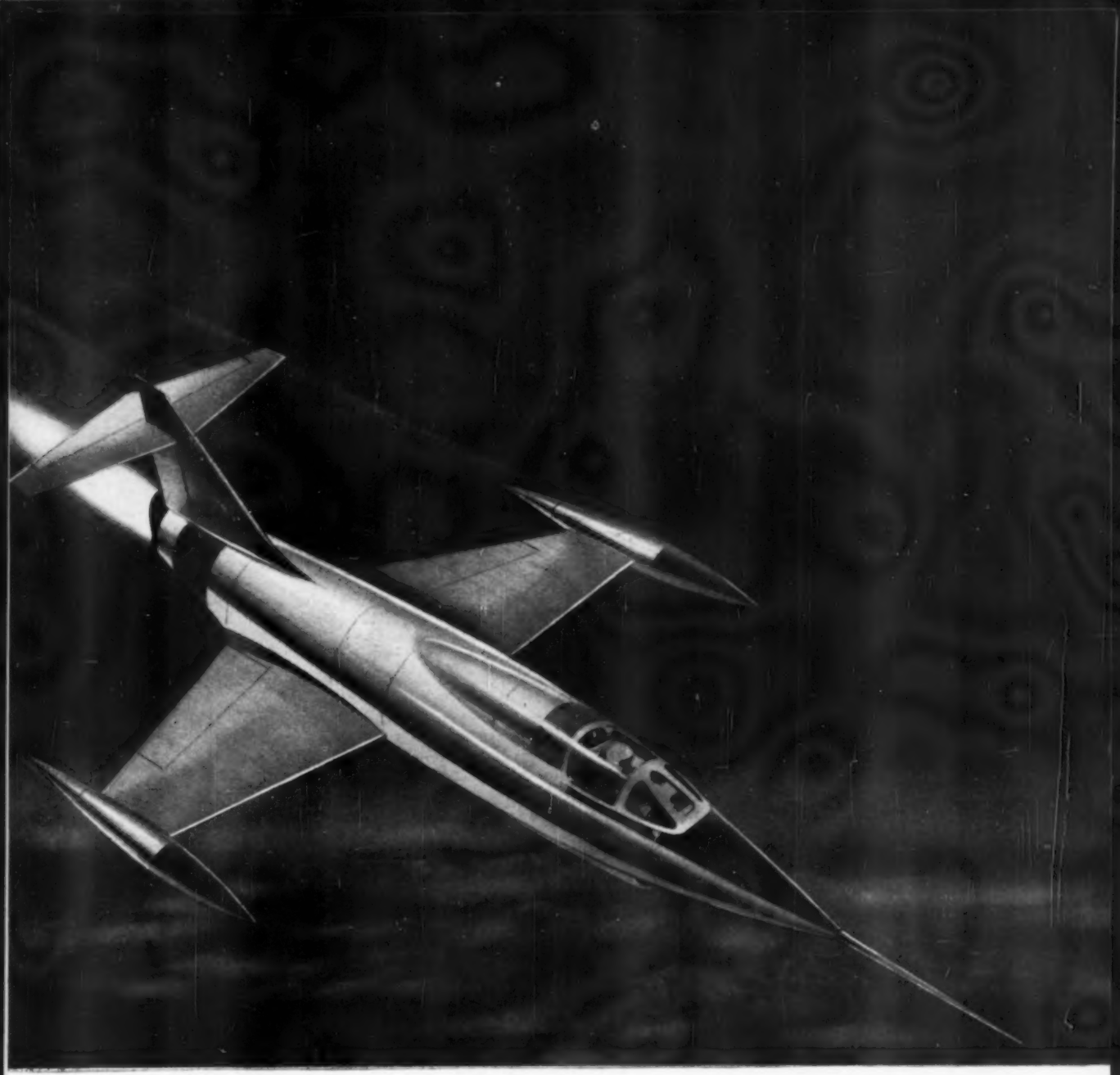


Let's not parboil the pilot when he reaches Mach 3.5

Right this minute scores of brilliant engineers are bent over drawing boards trying to achieve Mach 3.5.

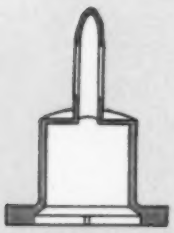
A crucial problem is, how not to parboil the pilot before you get him down to earth again. It will be *solved*.

Part of its solution will be controls that keep the pilot alert and the plane responding to controls. There Fenwal can — and probably will — be helping. For at each stage of aviation development Fenwal temperature controls, detectors and other instruments have been keeping up with the Mach's — and Jones, the pilot, too.

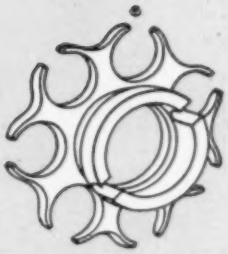
Fenwal has complete facilities in personnel, experience and equipment for helping your engineers on any problem of temperature control or over-heat detection. Your engineers will like what they find here. Inquiries are invited on problems new, old or just current. Write Fenwal Incorporated, 129 Pleasant Street, Ashland, Massachusetts.

Fenwal

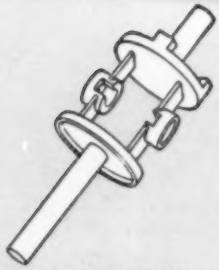
Controls Temperature . . . Precisely



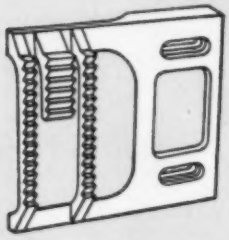
Here is an example of the complex internal coring possible with investment casting. Square, round, elliptical or irregular interiors can be cast.



The complexity of this part makes investment casting the only feasible method of manufacture. Prongs have perfect dimensional accuracy.



Here an entire assembly incorporating multiple functions is cast in one unit. "Keyhole" coring and a number of distinct surface details are required.

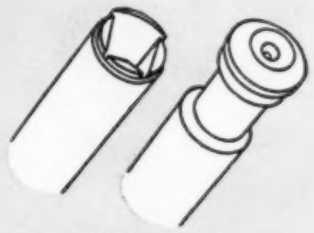


The sharp teeth of this sewing machine feed dog were cast in wear-resistant alloy to give longer wear than could be obtained from machinable material.

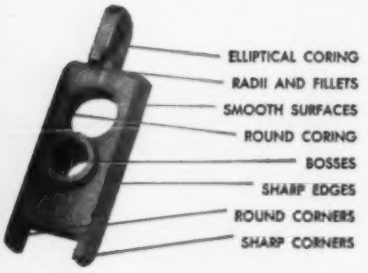
design with austenal in mind

In planning parts, design directly for Microcast and take advantage of its wide range of design possibilities.

See not only what you can do, but what costly, time-consuming operations Austenal investment casting eliminates.



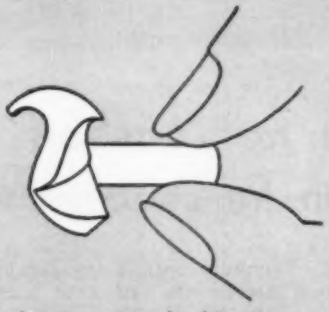
Cross-sections of irregular and varying thickness can be utilized. In this part the internal core diminishes from an irregular square to a small round hole.



These extrusion dies of wear-resistant alloy are readily mass-produced with highly complex and irregular internal contouring.

Walls of varying cross-sections are possible. Here wall thicknesses change from thin to very heavy, allowing strength without bulk.

This very small part measures 1⅛" wide and less than ⅛" thick. Its thinness, rigidity and detail were possible only by investment casting.



Shown here is an example of how investment casting can virtually eliminate hand-filing and machining by keeping uniform, intricate detail.

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6. Signal Generator Sensitivity: 10 mv/mr, with 55 m/a, 400 cps
7. Signal Generator Linearity Deviation: ± 1%
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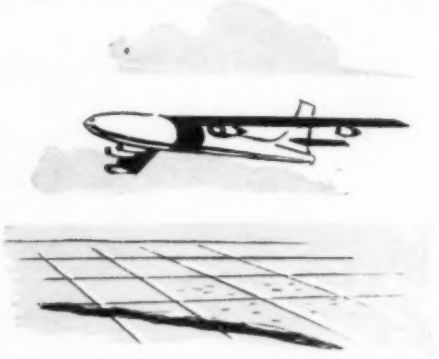
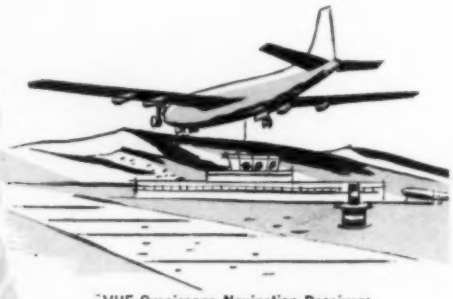


Airborne UHF and HF Communications Transceivers



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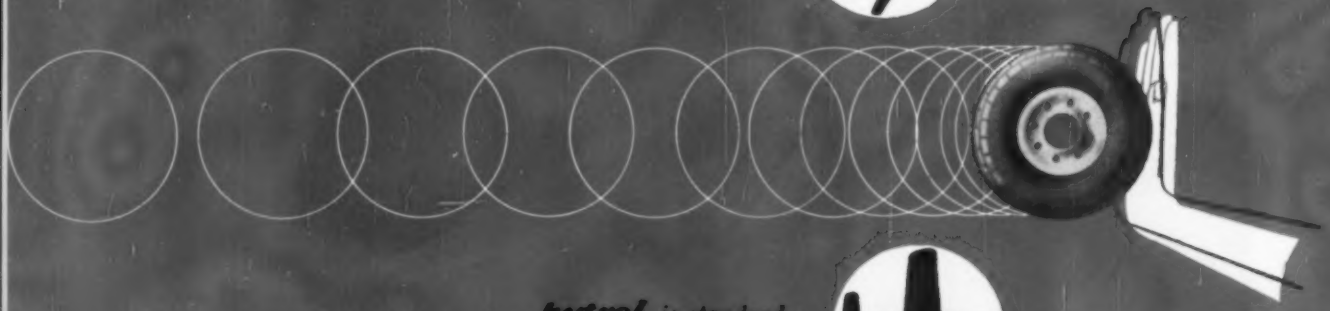

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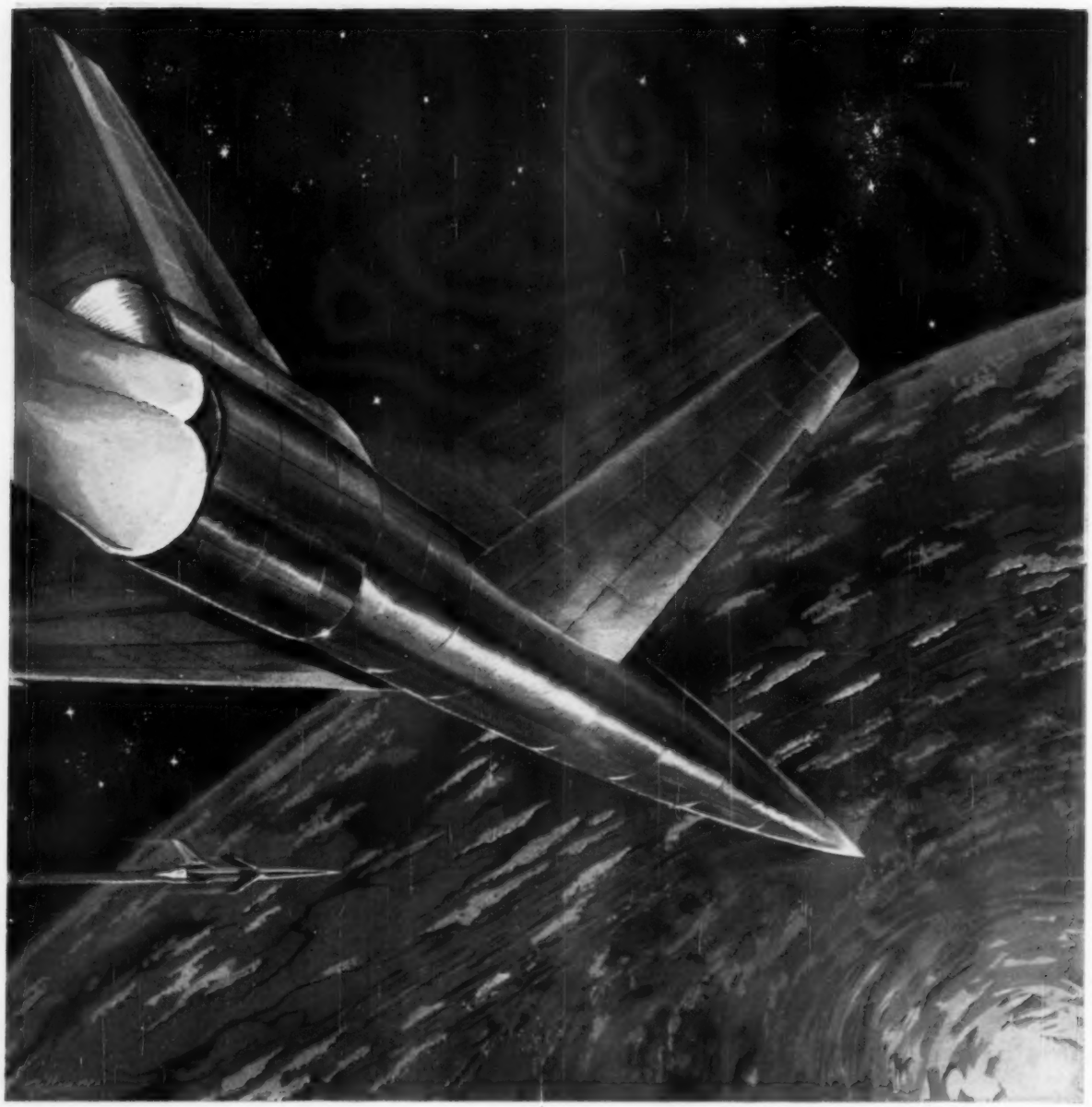

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SEPTEMBER 10, 1956

AVIATION WEEK

VOL. 65 NO. 11

New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Night LO 4-3035)

Editorial Offices Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630

Los Angeles 17—1125 West Sixth St., Phone: MAdison 6-9351

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

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Mary Whitney Fenton, Joan Read

British Emphasize Sales at Farnborough..... 26

► The emphasis was on sales rather than spectacular new achievements at the Society of British Aircraft Constructors Show.

National Aircraft Show a Military Operation..... 30

► Completing a trend that started with the end of closed course racing in 1949, show in 1956 was taken over exclusively by services.

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► Mockup of DC-8 shows off big jet transport to good advantage during Douglas' annual open house last week.

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COVER: De Havilland Comet III, aerodynamic prototype of Comet IV recently ordered in quantity by Capital Airlines (AW July 30, p. 29). Fifty-three million dollar order gave new vitality to de Havilland sales program following Comet disasters in 1954 that grounded Comet I. British Overseas Airways Corp., which ordered 19 Comets, was only previous customer.

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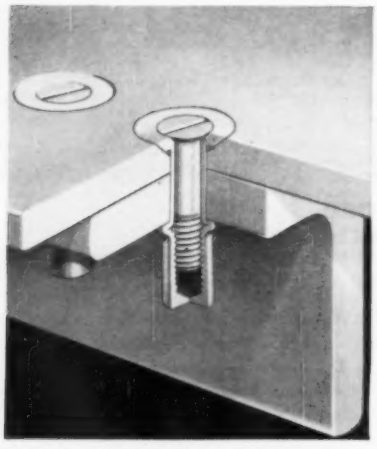
Lands big ones safely—BFG wheels, load-rated 60,000 lbs., give maximum strength with minimum weight on Boeing's B-47. What's more, this wheel stood up under test loads of 300,000 lbs.! B-47's dual wheel assemblies are equipped with B. F. Goodrich brakes.

B. F. Goodrich brakes stop Northwest's new 1049-Gs smoothly, give long maintenance with more even wear. When fluid pressure is introduced, a full circle "tube" lifts each brake block evenly around the full circle of the drum. The entire braking surface is utilized.



BFG Rivnuts give Tiger a longer leap
Grumman engineers form integral wing tanks of F11F-1 Tiger with top and bottom aluminum wing sections fastened together by new B. F. Goodrich Seal-Head Rivnuts—only one-piece blind fastener with threads. Fuel-tight Rivnut is approved for primary structures.

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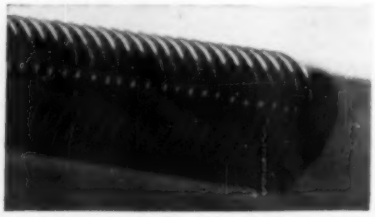

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EDITORIAL

International Technical Exchange

There is no more conclusive evidence of what a truly international business aviation is than a survey of the technical interchange between the U.S. and Great Britain during the post-war decade. At the Society of British Aircraft Constructors display at Farnborough, there is ample evidence of American technical advances that have been helpful to British aviation.

Most obvious are the Sikorsky helicopter designs being built in considerable quantity for British customers by Westland under a license from United Aircraft Corp. Less obvious, but even more helpful, are such American innovations as the flying tail now in evidence on all of the current British fighter crop that began their careers with conventional tails only a few years ago. The thin-winged Fairey Delta also can trace its conceptual ancestry to earlier American research on extremely thin wings of delta planform now embodied in the Convair F-102 already in service with USAF air defense squadrons. The low set horizontal tail and extremely serviceable high-altitude armament performance of the Folland Gnat traveled to England from California in the fertile brain of its designer W. E. W. Petter.

In the field of high-powered rockets required for long-range ballistic missiles, the British engine maker Rolls-Royce is breaking into this difficult technical field with the formal assistance of North American Aviation, Inc., which has amassed one of the largest stocks of experience in this new area.

On the other side of the Atlantic, Pratt & Whitney got its start in the jet engine business with licenses and technical assistance from Rolls-Royce. Curtiss-Wright is still building the Armstrong-Siddeley-designed Sapphire under license. Westinghouse has a technical interchange agreement with Rolls and is Americanizing the Rolls Soar turbojet for use in high-speed target drones. In the airframe field, Glenn L. Martin Co. is producing the British Canberra designed by Petter when he was with English Electric.

In the commercial field, British airlines have long flown on American designed and produced equipment, and they will continue to rely on it for the blue ribbon North Atlantic run for the foreseeable future. On the other hand, Capital Airlines has been a heavy buyer of British transports with orders for 70 Vickers Viscounts and 14 de Havilland Comet IVs. De Havilland also found an excellent market for its twin-engine Dove in the American executive transport field, although the four-engine Heron does not appear to be able to repeat this sales performance.

International technical competition also has spurred such combinations as the Boeing 707 jet transport powered by Rolls-Royce Conway bypass turbojets. There are other less obvious examples of technical interchange, such as the advanced research reports of the National Advisory Committee for Aeronautics and the Royal Aircraft Establishment.

All of this interchange, both on the technical and commercial levels, is a healthy indication of progress.

Since aviation has assumed such a vital role in national policy, it is inevitable that political considerations now more often dilute the sounder decisions that would result from purely technical and commercial analysis. Aviation leaders on both sides of the Atlantic must firmly resist any attempts to sacrifice technical quality in military equipment and operating economy in commercial aircraft to purely political influences.

This is a difficult task because the politicians who sit at the top of the aviation pyramid can use their control of the national purse strings and invoke restrictions of a spurious military security policy to stifle industry critics of any technically unsound or commercially bankrupt policies.

There are examples of technically brilliant men on both sides of the Atlantic who have had the ability and courage to fight vigorously against politically-imposed trends that they knew to be wrong and ruinous. Some of them may have suffered personally in their crusade, but the progress of aviation has moved fast and more surely in the right directions because of their efforts. All of us owe them a debt of incalculable gratitude.

Boost Traffic Controllers

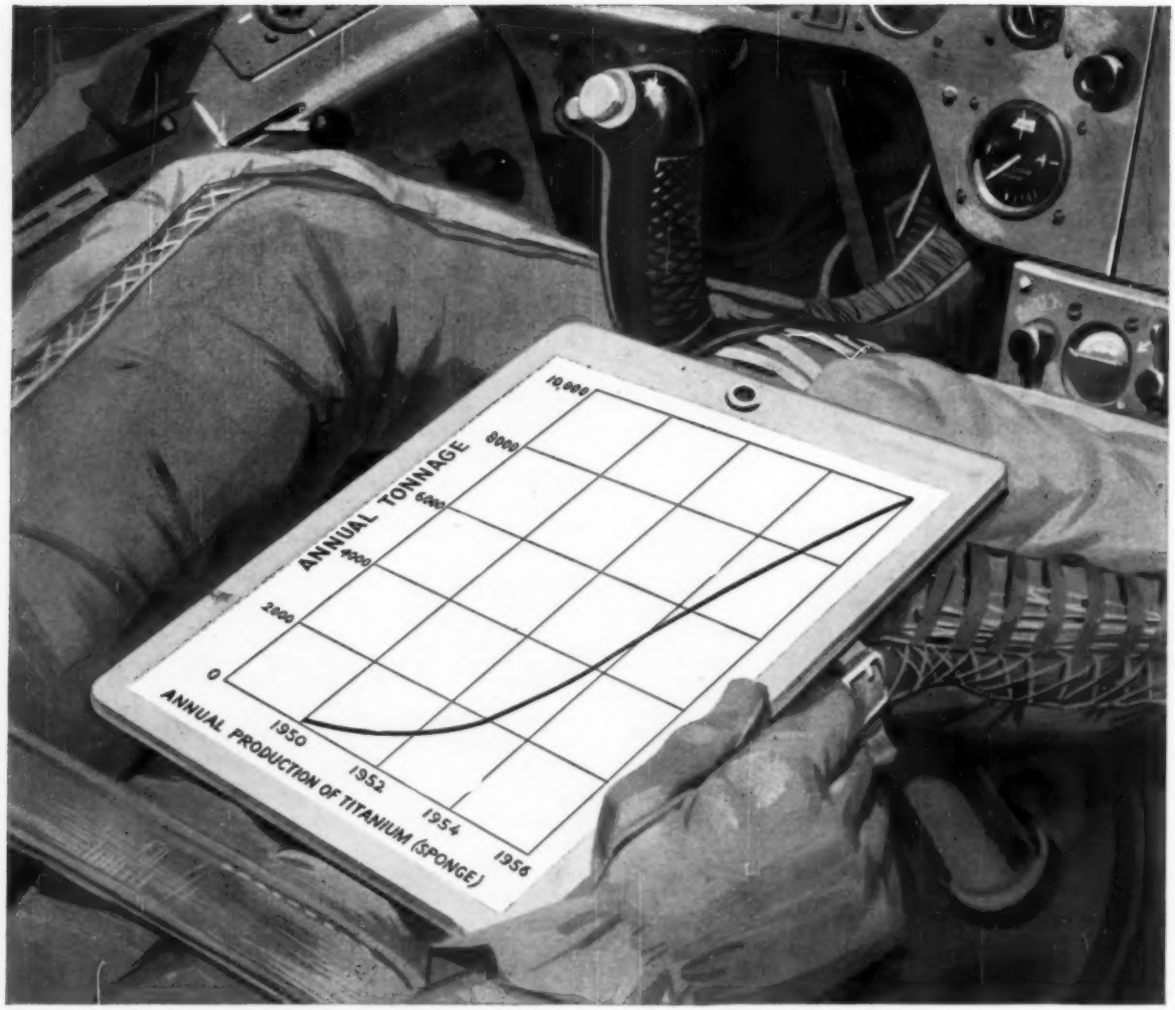
The business of controlling large masses of high-speed air traffic has put a new aspect on what used to be a routine operation. In the Douglas DC-3 era of airline operations, air traffic was so relatively light that it only required a tower operator with a radio and a pair of binoculars to handle it adequately. In the post-war era, with both the volume and speed of military and commercial air traffic greatly increased, bad weather flying has become routine, and the task of safely controlling air traffic has grown into a highly-complex job that requires not only a large assortment of electronic equipment but also highly-skilled personnel.

The avionics industry has done an excellent job in developing the equipment necessary for modern all-weather traffic control, but the government which operates the federal airways and traffic-control system has not matched this performance in developing and retaining the skilled personnel required to operate the system. It has lagged badly, both in providing proper technical training for new personnel and in the pay scale and working conditions for its senior, most skilled people.

Personnel policies governing the federal airways system and traffic controllers badly need revision in light of modern air-traffic problems. In the high-density traffic areas, the federal traffic controllers are responsible for the safety of millions of dollars worth of equipment and hundreds of lives every second they are on the job. In addition, the skillful handling of their job can mean the difference between profit and loss for airlines and the success or failure of a military mission.

The Civil Service Commission has made a recent attempt to reevaluate the controllers' pay scale, but it understood the problem so poorly that the effect of its recommendations would have made the job of senior controllers even less desirable. The air-traffic controller has been the forgotten man in all the hue and cry over better air-traffic control. He badly needs a modern pay scale commensurate with the vastly increased responsibilities of his job.

—Robert Hotz



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WHO'S WHERE

In the Front Office

Col. John L. Zoeckler, chief-Aircraft and Missiles Division, Wright-Patterson AFB, Ohio. He succeeds **Col. Carl F. Damberg,** now Deputy Commander, Air Materiel Force, European area.

John C. Markey, board chairman, Aero Equipment Corp., Bryan, Ohio. **Marquand J. Anderson** succeeds Mr. Markey as president.

John L. Weller, vice president, to hea new Department of Planning and Coordination, Trans World Airlines. Mr. Weller previously was assistant to the board chairman.

George Q. Mathews, vice president-sales, Huck Manufacturing Co., Detroit, Mich.

Roger M. Dolan, vice president-industrial relations, Thomas A. Edison, Inc., West Orange, N. J.

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John M. Eagleson, vice president-manufacturing, and **James A. Graham,** vice president-sales, Cambridge Corp., Lowell, Mass.

Changes

Merritt C. Chandler, assistant to vice president and division manager, **Edward J. Hoechst,** manager-employe relations, **Clayton C. Shafer,** manager-industrial engineering, and **John Barrett,** manager-production control, American Bosch Arma Corp., Hempstead, N. Y. also: **Ernest Glod,** employe relations manager, new Chicago Division.

Lee A. Woodworth, head of preliminary design, Propulsion Research Corp., Santa Monica, Calif.

Ralph A. Lamm, director-engineering, Pacific Division, Bendix Aviation Corp., North Hollywood, Calif. also: **E. Wayne Copeland,** assistant sales manager-telemetering.

Marcus C. Eliason, general sales manager, Air Associates, Inc., Teterboro, N. J.

Samuel Storchheim, chief-manufacturing engineering and research, Nuclear Division, Martin Co., Baltimore, Md.

K. F. Umpleby, assistant general manager and **W. H. Sims, Jr.,** chief engineer, York Division, Bendix Aviation Corp., York, Pa.

Richard E. Tisch, manager-new Product Development, Engineering Department, Minnesota Rubber & Gasket Co., Minneapolis, Minn.

Fred S. Miller, assistant resident manager, solid rocket plant, Aerojet-General Corp., Azusa, Calif. Also: **Dr. Raymond H. McFee,** director of research, Electronics and Guidance Division.

Sol W. Voorhes, director-commercial sales, Weber Aircraft Corp., Burbank, Calif.

Rear Adm. William H. Ashford, Jr. (USN, ret.), manager, newly formed Missile Applications Division, Exide Industrial Division, Electric Storage Battery Co., Philadelphia, Pa.

Jack Nichols, director-advertising, Northwest Orient Airlines.

(Continued on page 147)

INDUSTRY OBSERVER

(Editor's Note: This column was prepared by a team of Aviation Week editors who attended the National Aircraft Show in Oklahoma City.)

► Fairchild is prepared to demonstrate the utility of C-123 assault transports for use aboard Navy carriers. Top Navy officials will hear Fairchild's presentation this week and possibly order an evaluation of the idea which is designed to increase Marine mobility.

► Lockheed will soon announce development of a radically-designed pilot escape unit. The structure is designed to protect a pilot from wind blast and high accelerations at speeds up to Mach 2 and altitudes up to more than 50,000 ft.

► Douglas Aircraft Co. is going ahead with plans to equip its F5D Skylancer with the Pratt & Whitney J57 engine despite proposals that the Navy fighter be equipped with the General Electric J79. Douglas believes benefits of change are outweighed by the fact that the aircraft was designed specifically for the J57.

► Hartzell three-blade feathering propeller will be convertible to the company's new reversible pitch configuration by means of a modification kit costing $300-$400. New hydraulically-activated reversible pitch propeller was demonstrated for the first time during the National Aircraft Show by Aero-Design on a Model 560-A Commander.

► U. S. Marines are testing a one-man light-weight Gilfillan radar for ground-control approaches. Total operating weight is 4,475 lb.

► Navy is showing an interest in Bell Aircraft Corp.'s proposal for a triple-turbine helicopter (AW Mar. 19, p. 80). On the commercial side, both New York Airways and Sabena Belgian World Airlines still would like to see military support for the development.

► USAF has opened bids from 31 companies competing for the contract to run the Army's primary fixed-wing pilot training course at Gary AFB, San Marcos, Tex. Winner should be determined by Sept. 25.

► USAF, still struggling with personnel problems growing out of the complexity of modern aircraft, is putting pressure on designers to simplify maintenance. One firm already has established a maintenance engineering shop to monitor design engineering and keep check points accessible.

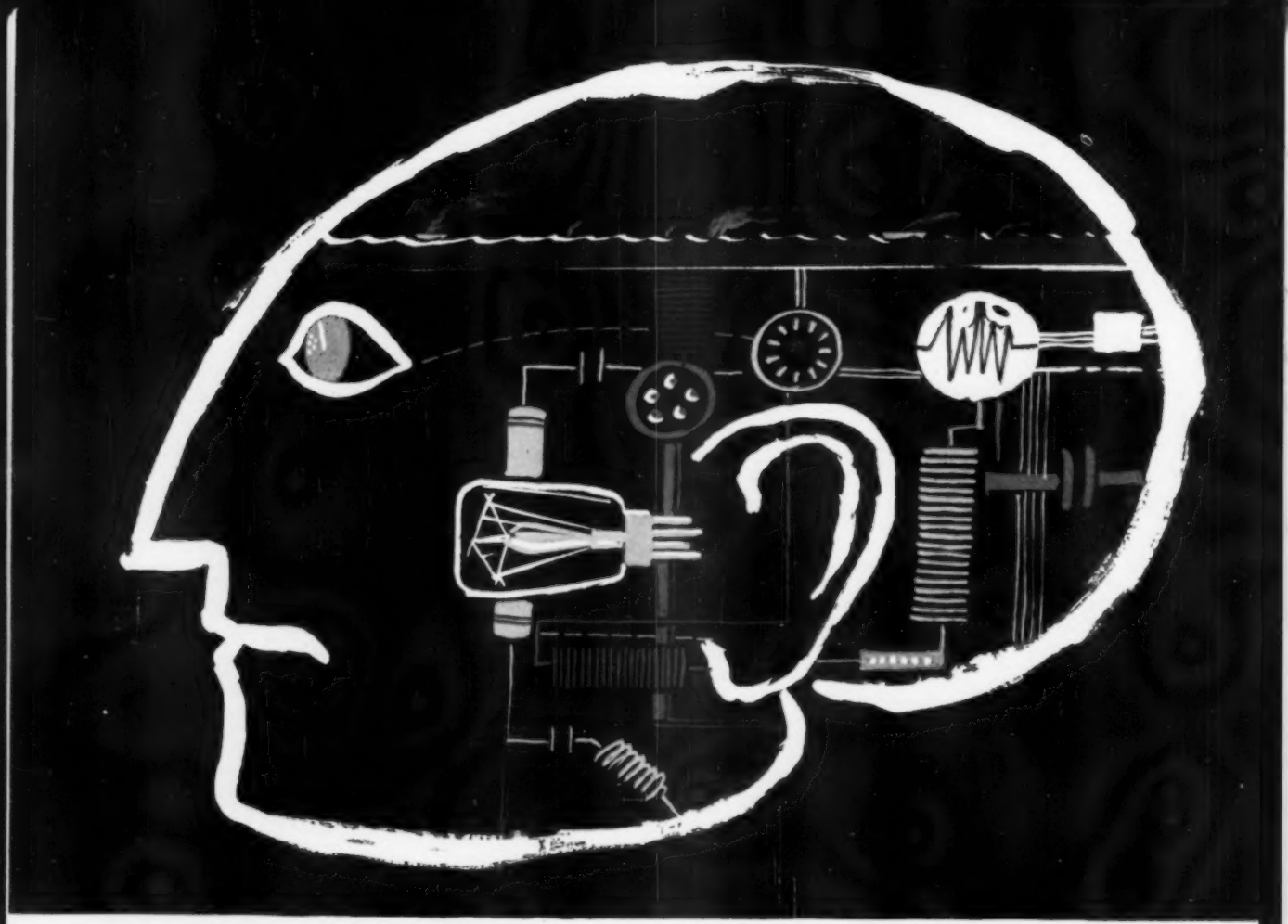
► Future production models of the Sperry Sparrow air-to-air missile will be painted white to blend with the new grey-and-white color scheme of Navy combat aircraft. Current missiles are black.

► None of the Boeing B-47 medium jet bombers in the General Electric Trophy Race was built at the company's main plant in Seattle. Two of the aircraft came from the Boeing plant in Wichita, Kan., one was made by Lockheed in Marietta, Ga.

► USAF's Northeast Air Command will get 10 Fairchild C-123s equipped with ski landing gear and auxiliary turbojet engines. They will be used for ice-cap transport missions, replacing the present DC-3s.

► Navy's Blue Angel's precision flight team, which would like a newer plane than Grumman F9F-8 Cougar, has considered Grumman F11-F Tiger and Chance Vought F8U Crusader, might possibly settle on Douglas A4D as having speed and maneuverability to compete with new F-100Cs of the Air Force Thunderbirds precision team. Air Force this year made a point of the fact that Thunderbirds, with tighter turns, kept planes within sight of crowd at all times.

► Pilots of F-100Cs in Bendix Trophy Race had permission to use aerial refueling if necessary on the 1,120-mi. course. None took advantage of the opportunity, but one plane landed with an empty fuel tank. Winner had only 20 gal. remaining at end of flight.



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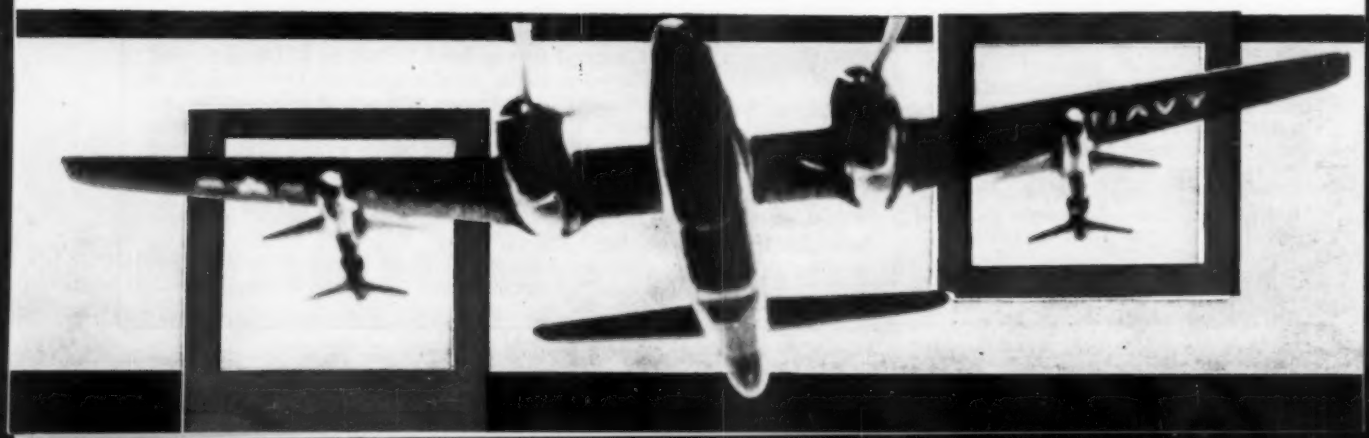


Washington Roundup

Douglas as USAF Secretary?

Friends of USAF Undersecretary James H. Douglas, Jr. are again speculating that he may become top executive of the department, replacing Donald A. Quarles, who is the current favorite to succeed Charles E. Wilson as head man in the Pentagon. Douglas, mentioned prominently for a promotion when Harold E. Talbott was dropped last year, lost out to Quarles. He is now reportedly taking an increasing role in the determination of Air Force policy and is popular with uniformed USAF personnel. Wilson is expected to step down after the November election.

'Classified'

Defense Department's extensive study of the aircraft development cycle and how it can be shortened is "classified because of military security," and all efforts to get an adequate account of its contents for U. S. aircraft manufacturers are being rebuffed. Paradoxically, a brief Pentagon announcement on the subject says the group has recommended greater dissemination of technical information to contractors.

The report also urges simpler procedures covering contractor relationships, better-informed decisions and more vigorous management of approved projects, all matters that have been emphasized by industry and Defense Department critics in recent months. Manufacturers who have been involved in design competitions will applaud a recommendation that the armed forces give more attention to the development of operational requirements.

Superiority and Security

Gen. Curtis LeMay, commander of the Strategic Air Command, has challenged USAF Secretary Donald Quarles' position that U. S. airpower can serve as an effective "deterrent" force—even if it is not relatively superior.

At the Air Force Assn.'s annual convention, Quarles maintained that it is only necessary to have a force capable of delivering a devastating counter attack. "Neither side," he said, "can hope by a mere margin of superiority with airplanes or other means of delivery of atomic weapons to escape catastrophe in such a war."

Gen. LeMay, however, recently insisted: "You have to have more combat potential if you are going to be a deterrent force."

Turbine Transport Review

Major topic of discussion at this week's Airworthiness Review in Washington will be the special regulations for turbine transports proposed by the Civil Aeronautics Board, although the airlines and the manufacturers are not yet ready to comment on them. The industry feels that the Special Civil Air Regulation proposed in Draft Release 56-20 (AW Aug. 20, p. 43) is too complex for immediate comment and has asked for an extension of the time limit for comments from Oct. 15 to Jan. 15.

Airlines and manufacturers will present a united front in discussions with the CAB on the special regulations. Five companies now building turbine transports—Boeing, Douglas, Convair, Lockheed and Fairchild—will study the effect of the proposed rules on jet operations. They may be joined by British manufacturers Vickers-Armstrong and de Havilland. The manufacturers will turn their performance data over to the airlines for study in relation to their route systems. Then the industry will present its views to the CAB.

CAB's plan to make its proposed rules retroactive does not make the industry particularly happy, but the issue probably will not be heavily disputed.

Boom Troubles

USAF's sonic boom troubles followed it to the National Aircraft Show at Oklahoma City. Plans to launch the Air Force portion of the flying show with a series of booms were canceled abruptly when practice flights wreaked havoc at the airport, surrounding homes and farms. Plate glass windows at Will Rogers Field were smashed, ceilings allegedly fell, and rural residents complained that their wells were shut off by the loud noise. The CAA threatened to withdraw show waivers if the program went through and the management grew concerned about its insurance problem. USAF's Gen. Edwin W. Rawlings, co-ordinator for the show, ordered the boom exhibition canceled and the pilots held off for the first day. However, the General remained convinced that the public should be familiar with the noise as part of USAF's education effort. On the remaining two days, the sonic booms were introduced under carefully controlled conditions.

There was no damage.

Soviets and F-104

Defense Department officials refused to allow Lockheed F-104 Starfighters be put on static display at the National Aircraft Show in Oklahoma City—even though a plane load of foreign attaches (including Russians) who landed at nearby Tinker AFB to attend the show got a quick look from a short distance at two of them parked in an open hangar.

Later, an assistant Russian air attache was asked what he thought of the aircraft show.

"I find the people very interesting," he said.

Asked what he thought about the aircraft—including the two F-104s, which made low-level passes across Will Rogers Field each day of the show—the attache replied:

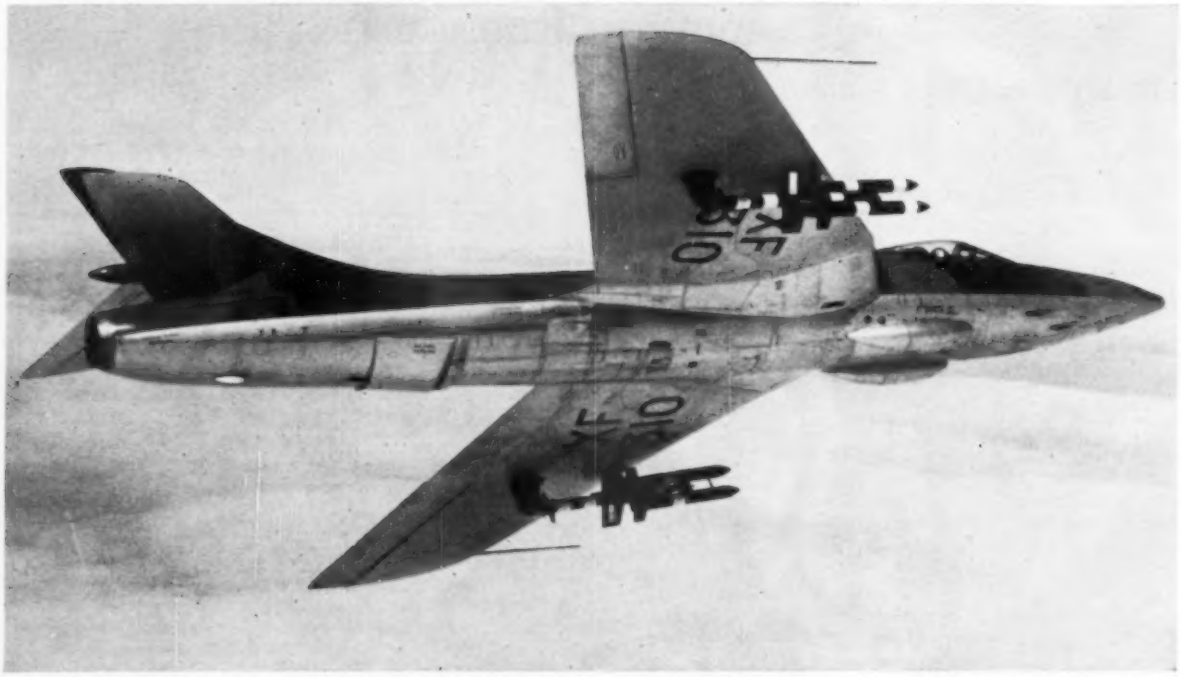
"I find they reflect the people who make them, and I find the people interesting."

Machinists' Bargaining Plank

International Assn. of Machinists (AFL-CIO) has drafted new plans designed to strengthen its bargaining position in the aircraft and guided-missiles industry, where, union leaders say, "plant dispersal and abnormal plant expansions . . . have generally tended to weaken the overall . . . position." Moves will include a proposal for a closer tieup with the United Automobile and Aircraft Workers (UAW).

In its next round of negotiations, the union will demand "substantial wage increases," a full union shop and a job protection program for employes when aircraft and missile production is dispersed or relocated.

—Washington staff



FAIREY FIREFLASH air-to-air missile mounted under wings of Hawker Hunter Mk. 6 is going through service development tests.

British Emphasize Sales at Farnborough

By Robert Hotz

Farnborough, Hants, England—Emphasis was on sales rather than spectacular new technical achievements at the 17th display of the Society of British Aircraft Constructors last week at Farnborough. New orders for Rolls-Royce Conway engines, Bristol Britannia transports and Westland-built, Sikorsky-designed helicopters, although small, stirred more interest than anything in the air or under the huge exhibition tent. London daily papers which in years past have screamed "Britain leads the world in the air" with black front page headlines, this year are covering Farnborough with small, restrained stories usually well buried inside as the promised technical developments of the supersonic era have failed to materialize.

SBAC, however, notes with considerable satisfaction that aircraft and engine exports for the first seven months of this year reached $170 million, which is only $14 million short of the total for all of last year. This gives British manufacturers the feeling that their development work of the past decade, particularly in gas turbine engines and jet transports, is paying off well in foreign sales so vital to sustain the British economy. Last year's total of $184 million was the peak of a steady rise from the 1950 total sales of $95 million.

NAPIER SCORPION rockets are mounted in protuberance at rear of Canberra bomb bay.

Little New

Technically there was little new in this year's show. There were no basically new airframes shown, although some new variants of familiar shapes such as the Supermarine twin Avon-powered naval fighter, the de Havilland 110 naval fighter, the Bristol Britannia and the Vickers Viscount, were flown.

Only truly supersonic aircraft displayed was the Fairey Delta, holder of the world official speed record of 1,132 mph.

Bad weather combined with official timidity restricted the planned performance of two Fairey Deltas flown by Peter Twiss and Gordon Slade in a head-on pass, with each Delta doing Mach 1.8 or better than 1,000 mph. This pass, with a closing speed of 2,000 mph., was planned at contrail level

above 30,000 ft., where the progress of the two Deltas could be clearly visible from the ground. But 30,000 ft. clear visibility is too much to expect from English weather. After sonic booms roused the countryside during the Delta rehearsals, the Ministry of Supply restricted the runs to 825 mph. Typical shower and sunshine weather during the first three days of the show made it impossible to attempt even these slower passes.

Close to Disaster

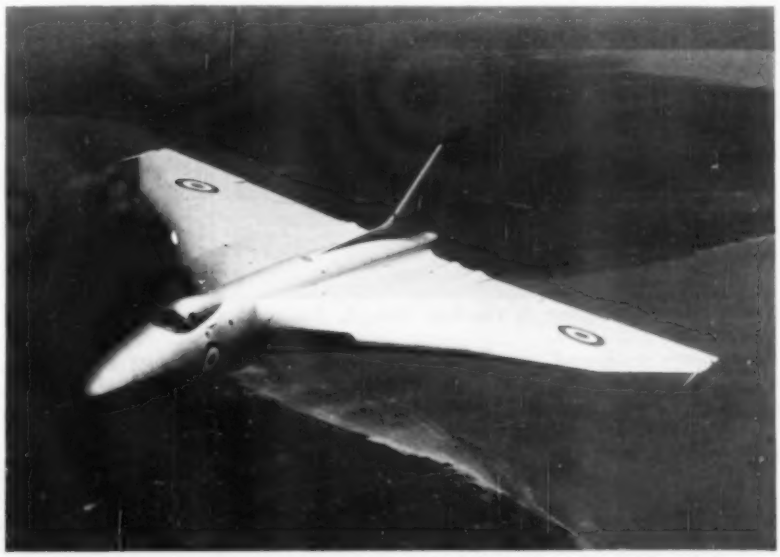
The Delta flown by Peter Twiss shaved dangerously close to disaster in the second day's flying when three braking chutes popped out during a takeoff run. Twiss was too far committed to abort the takeoff when Farnborough tower warned him of the dragging chutes. He cut in the Avon afterburner and released the chutes, pulled safely off the runway and continued his flying display. Delta pilots did a fine job of flying their machines under restrictions imposed by weather and officialdom.

There is no doubt that the Royal Air Force would like to have a fighter version of the Fairey Delta design well along toward squadron service, but there is no sign that anything except talk exists of producing an operational design from the present research plane configuration.

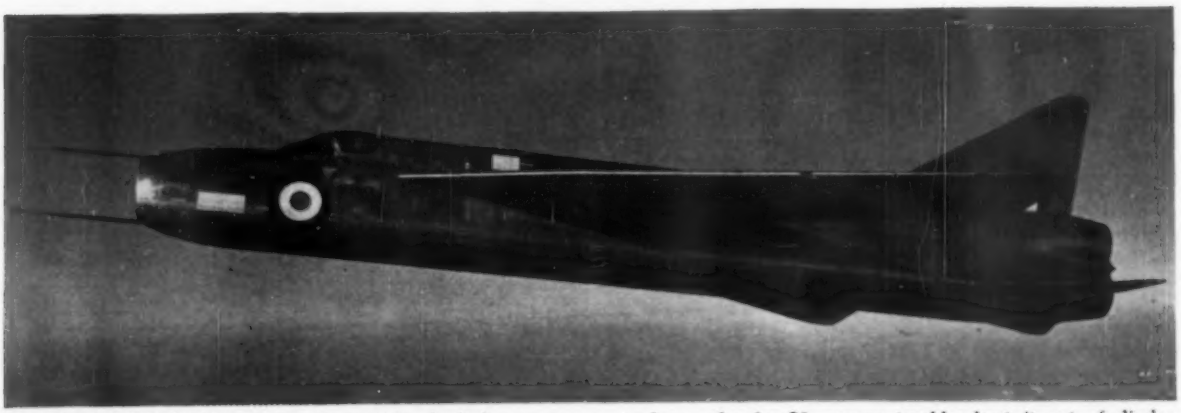
The only other truly supersonic aircraft of British design, the English Electric P.1, was not shown at Farnborough because of canopy trouble. A recent series of canopies popping loose in flight has forced a design change that abandons the manually releasable canopy latch and substitutes a cartridge ejection release. There is only one P.1 now available with the canopy and it is being used for development work. English Electric has built only five P.1s out of an initial development order for 20 placed two years ago, indicating it will be some years before Royal Air Force gets truly supersonic interceptors.

The display of fighter aircraft at

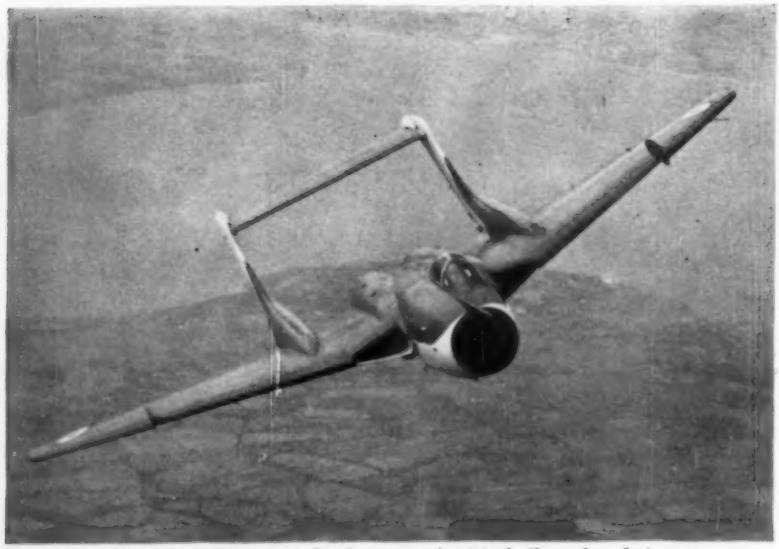
ROLLS-ROYCE TYNE turboprop engine flew in Avro Lincoln test bed at Farnborough.



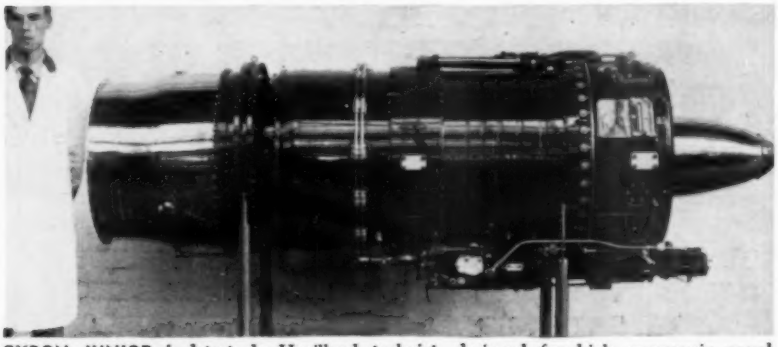
VULCAN, one of two RAF heavies, may get new 16,000-lb. thrust Olympus engines.



ENGLISH ELECTRIC P.1 prototype is one of five built by company out of an order for 20; canopy troubles kept it out of display.



DH 110 for Royal Navy is current development of original all-weather design.



GYRON JUNIOR is latest de Havilland turbojet, designed for high supersonic speed.

Farnborough confirmed the fact that Royal Air Force fighter equipment is now lagging two design generations behind USAF and at least one behind the Russian air force. Even the improved Hunter Mark 6 with the more powerful Avon engine plus all-flying tail still needs a shallow dive to get supersonic. The controversial Gloster Javelin delta all-weather fighter appeared in its Mark 7 version and trainer model. It is significant that the subsonic Javelin is going into Royal Air Force operational service about the same time USAF is getting large numbers of Convair F-102 supersonic deltas equipped with operational air-to-air missiles.

Fairey Fireflash

The Fairey Fireflash missile, the equivalent in function to the Sperry Sparrow and the Hughes Falcon, appeared in a flying display mounted on the wing pylons of the Hunter Mark 6 and Supermarine Swift Mark 7 but is not in operational use on either fighter, while Falcons and Sparrows have been operational many months with USAF and Navy.

The Folland Gnat, now powered by the 4,000 lb. thrust version of the Bristol Orpheus engine, gave a striking demonstration of lively performance piloted by Ted Tennant. This Gnat is the first fully-armed version carrying two 30 mm. Aden guns, and it has had successful firing trials at 40,000 ft. with no problems structurally, from gun gases, or from ejected cartridge casings, as encountered in other British fighters. Folland is now developing a two-seater trainer version of the Gnat with the second seat raised for better instructor visibility and a special-version Orpheus operated at lower temperature and power for better fuel consumption, longer endurance, and better overhaul intervals.

No guns will be carried; the space will be used for more fuel. The trainer tail will have an arrangement to lock the elevator and horizontal fin into a single-surface, all-flying slab type of tail to give students experience in high-speed control problems. The overall future of the brilliantly conceived and executed Gnat project appears dim. Neither NATO nor Royal Air Force orders are likely, and negotiations for production in India have dragged so long now the suspicion is growing that India may be switching to Russian fighters supplied on a deal similar to the Egyptian cotton barter.

Those two perennial naval fighters, the Supermarine twin Avon-powered 113 and the de Havilland 110, appeared in new versions, but they are still not aboard carriers in service. The Supermarine 113 is still a prototype. The production version is expected to have a blown flap arrangement for better takeoff and landing performance. De Havilland has beefed up the troublesome twin tail boom of the 110 and generally cleaned up the design so that it has been dived successfully to Mach 1.5.

Bomber Display

The bomber display included all of the V series—Vickers Valiant, Avro Vulcan and Handley Page Victor. However, the most spectacular flying was still provided by R. P. Beamont, who is now piloting the Canberra PR.9 high-altitude photo reconnaissance version.

With a pair of better than 10,000 lb.-thrust Avons powering this version, plus added wing area gained by extending the tips and increasing the chord inboard of the engine nacelles, this Canberra has been operating in the 65,000 ft. altitudes not far below the official world altitude record.

A Vickers Valiant demonstrated a rocket-assist takeoff with a pair of de

New British Engines

A 16,000-lb. thrust rating—highest yet announced for any British turbojet—has been credited officially to the Bristol Olympus BO1.6. Thrust is developed without afterburner; it is 4,000 lb. higher than the rating of the Olympus 11 now in production and approved for service.

Overall length of the new Olympus model is 152 in., and diameter is just under 41 in. The engine is a split-compressor type and uses a single annular combustion chamber.

Announcement of the new Olympus was made just before the SBAC display.

De Havilland's Gyron Junior was displayed in the static exhibits at Farnborough, but this engine's rating still is undisclosed. The Gyron Junior is designed with low specific weight and small frontal area for application, in combination with liquid-propellant rocket engines, to tactical aircraft with high supersonic speeds.

Estimated thrust range of the Gyron Junior is from 8,000 to 11,000 lb. for a weight of about 1,500 lb. Test engines have been run at their design thrust, the company says.

Reds Confirm 1,000 mph. Speeds

Farnborough—Official confirmation that the Russians are flying aircraft in the better than 1,000 mph. speed range was given here by Soviet Aircraft Production Minister P. V. Dementiev. Aviation Week reported from Moscow in July that the new Super Farmer MiG-21 had performed in the 1,200 mph. speed range (AW July 2, p. 26). Also believed to be in the Mach 1.5 range were the new delta designs of Pavel Sukhoi, flown publicly for the first time during the Tushino air show on June 24.

Dementiev, after inspecting the Fairey Delta research plane, holder of the official world speed record of 1,132 mph. told correspondents through an interpreter that "we have planes flying that are faster than this."

Dementiev headed the Russian delegation of aviation technicians who visited the SBAC show at Farnborough, inspecting planes displayed on the ground, witnessing the flying display and taking a ride in the Bristol Britannia. They also toured British aircraft plants after the Farnborough visit.

Included in the Russian delegation were Oleg Constantinovich Antonov, transport designer who Dementiev identified as teaming with Andrei Tupolev on a large new turboprop transport design also reported by Aviation Week from Moscow in July; V. T. Litvinov, director of Aircraft Factory No. One in Moscow, where Ilyushin 14 transports now are produced, and D. S. Markov, deputy to Tupolev.

A Russian military delegation headed by Marshal Pavel Zhigarev, chief of the Red air force, and Marshal V. A. Sudets also visited the Farnborough show and toured British factories in civilian clothes.

The SBAC show attracted 6,500 military and civilian aviation people representing 120 countries. Six planeloads of USAF and Navy brass arrived in London for the show, including Dudley Sharp, USAF Assistant Secretary for Materiel; Lt. Gen. Thomas Power, ARDC commander; Lt. Gen. Donald Putt, deputy USAF chief of staff for development, and Lt. Gen. Clarence S. Irvine, deputy USAF chief of staff for materiel.

SBAC had a record number of 338 exhibitors at its 17th show, which had the distinction of being the largest, if not the most exciting technically.

Havilland Super Sprites providing an additional 8,000 lb. thrust for 12 seconds, long enough to kick the big bomber off the runway in an extremely short distance and give it a spectacular climb-out performance. The jettisonable Sprites will be standard equipment for Valiants, enabling them to operate off short, unimproved runways. Valiant also is well along in the development of flight refueling equipment based on the U. S. Navy buddy concept. Combination Sprites and aerial refueling should make the Valiant an extremely flexible bomber delivery system for nuclear weapons.

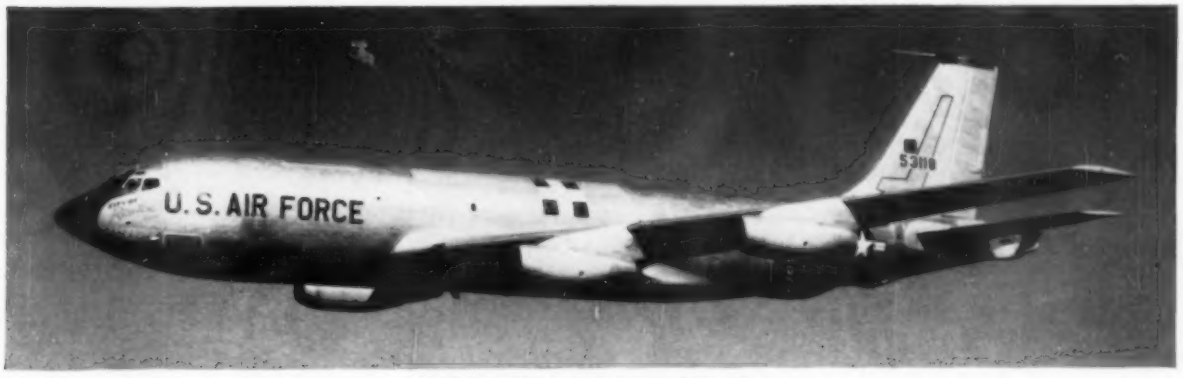
Royal Air Force acrobatic teams participated for the second year with a quartet of Hunters doing formation acrobatics in a sedate style hardly up to the Navy's Blue Angels or USAF Sky Blazers. A quartet of RAF Canberras provided one of the most unusual formation acrobatic demonstrations ever seen by hurtling their 21 ton bombers around in tight formations and perfectly timed sequence maneuvers.

A wide variety of flying test beds displayed a full showcase of British engines. Among the new hybrids fitted for development test work were:

- **Britannia 101** carrying the Orion supercharged turboprop in one nacelle and a Proteus 755 turboprop in another, plus two Proteus 705s as standard power.
- **Canberra equipped** with two Napier Scorpion rockets in the belly.
- **Lincoln carrying** the Rolls-Royce Tyne turboprop in the nose.
- **Canberra powered** by two Rolls-Royce Avon Mark 29s, a commercial turbojet offering 10,500 lb. thrust and specific fuel consumption of .775.

Napier wished to display the Convair liner powered by two of their Eland turboprops but were prohibited by SBAC rules for the show which bar non-British products. It is no secret that with the growing sales of British engines in foreign transport markets, the engine makers would like to change the rules to permit them to show their products powering foreign airframes. They argue that this is the best possible proof to potential foreign customers of the world-wide acceptance of British engines even by foreign airframe manufacturers.

However, American designs crept into the SBAC show in the shape of two Sikorsky helicopters now being built by Westland under license. Shown in Royal Navy colors were a Westland-built Sikorsky S-55 and two Westland Widgeons, which were five place jobs modified from the Sikorsky S-51 design.



KC-135 Maiden Flight

First production model of Boeing's KC-135 Stratotanker made its maiden flight Aug. 31 with R. L. (Dix) Loesch, Boeing senior experimental test pilot and A. M. (Tex) Johnston, chief of flight test, at the controls. The new tanker-transport being built for USAF's Strategic Air Command took off from Renton Municipal Airport at Seattle and landed at Boeing Field after 1 hr. 19 min. of flight. The big, four-jet plane, "City of Renton," was first jet transport type to come off a production line in Western Hemisphere. KC-135 will provide aerial refueling for jet bombers and fighters at jet speeds and altitudes. It is being produced in quantity for SAC at Renton, along with 707 jet luxury liners for commercial airlines.

Service Rivalry Highlights U. S. Air Show

By Claude Witze

Oklahoma City—The 1956 National Aircraft Show was a demonstration of military capabilities.

Completing a trend that started with the end of closed-course racing in 1949, the show this year was taken over entirely by the Defense Department to the complete exclusion of all other aviation interests.

The U. S. Army, Navy and Air Force, obviously spurred by a hot year of Pentagon wrangling over missions, manpower, budgetary favor and weapon-system control, went all out to demonstrate what they can do with airpower and air mobility.

Each program clearly was designed to exhibit as much as possible of the capabilities that will support the individual branch in the next real struggle for jurisdiction over weapon systems.

The three-day Oklahoma City crowd of 151,293, down sharply from the 1955 Philadelphia attendance of 289,880, saw these manifestations of keen interservice rivalry:

Interservice Competition

• **Navy carrier Shangri-La** cruising up the West Coast from Mexico to Oregon, launched daily flights of jet fighters and attack planes for speed runs to the aircraft show. Two flights of Douglas A3D Skywarriors passed over the crowd at Will Rogers Field and then returned to the carrier or a distant home field, demonstrating range capability to reach an inland target on flights of more than 2,500 mi. The fighter aircraft were McDonnell F3H Demons, which landed at the airport after 1,500 mi. flights in little more than two and a half hours. Fighters with refueling capability could have returned to the Shangri-La.

• **USAF's Strategic Air Command** flew Boeing B-47 medium jet bombers from England and North Africa, in addition to staging a B-47 race for the General Electric Trophy over the 1,900 miles course from Bermuda to Oklahoma City. The course was chosen for the challenge it offered to pilots and navigators, flying against the prevailing wind. It was the first time a National Aircraft Show trophy race started outside the continental U.S.

• **Aerial refueling** of three B-47's by three KC-97 tankers was shown for the first time, also by the Strategic Air Command.

• **USAF's Tactical Air Command** commandeered the Bendix cross-country race, flying six North American F-100C jet fighters over the 1,120-mi. course from George AFB in California. Winning plane was clocked at 666.661 mph. With aerial refueling, range could have been extended, pointing up TAC's emphasis on its contribution to deterrent air power.

• **Army set a new helicopter** endurance record, keeping a Bell H-13 in the air for 57 hr., 50 min., an accomplishment that would have been impossible less than five years ago. Transmission life of the Army's first Bell helicopters was 25 hr.; this has been extended to 500 hr.

• **Army's new and powerful Sikorsky** H-34 helicopter was used to airlift by external sling such equipment as 106 mm. recoiless rifles, 75 mm. pack howitzers and quarter-ton jeeps. In addition, aerial refueling of a Vertol H-21 helicopter from de Havilland U1A fixed-wing plane indicated growing Army confidence that it eventually will provide a large share of its own air mobility.

• **Marine Corps F9F-8** Grumman Cougars were used to show that supplies can be dropped to Marine ground forces from speeding jet aircraft.

The air show emphasis on military capability was carried out in static military and industrial exhibits. Paid space in two industrial hangars was almost entirely taken up by Defense Department contractors.

Increased Navy Interest

An important factor in this year's military domination of the show is a fresh approach by the Navy, instigated by Adm. Arleigh Burke, chief of naval operations. Navy's entry into the Thompson Trophy event is attributed to his interest (AW Aug. 20, p. 32).

Ben Franklin, general manager of the National Aircraft Show, said Adm. Burke's decision of last year to take greater interest in the Labor Day event had resulted in greater efforts by Navy contractors. In addition to the Thompson Trophy, Navy had Douglas, North American and McDonnell awards to shoot for and offered its best flying and

Aircraft Show Trophy Winners

• **Thompson Trophy,** to Cmdr. Robert W. (Duke) Windsor of Naval Air Test Center, Patuxent River, Md., who flew the Chance Vought F8U Crusader to a new national speed record of 1015.428 mph. Flight was made at Naval Ordnance Test Station, China Lake, Calif., on Aug. 21.

• **Bendix Trophy,** to Capt. Manuel J. (Pete) Fernandez, assistant group operations officer, 413th Fighter Day Group, who flew the North American F-100C from George Air Force Base, Victorville, Calif., to Oklahoma City, a distance of 1,120 miles, at an average speed of 666.661 mph. Capt. Fernandez and five other entrants from the Tactical Air Command all beat the old record, set in 1954 by a Republic F-84, of 616.208 mph.

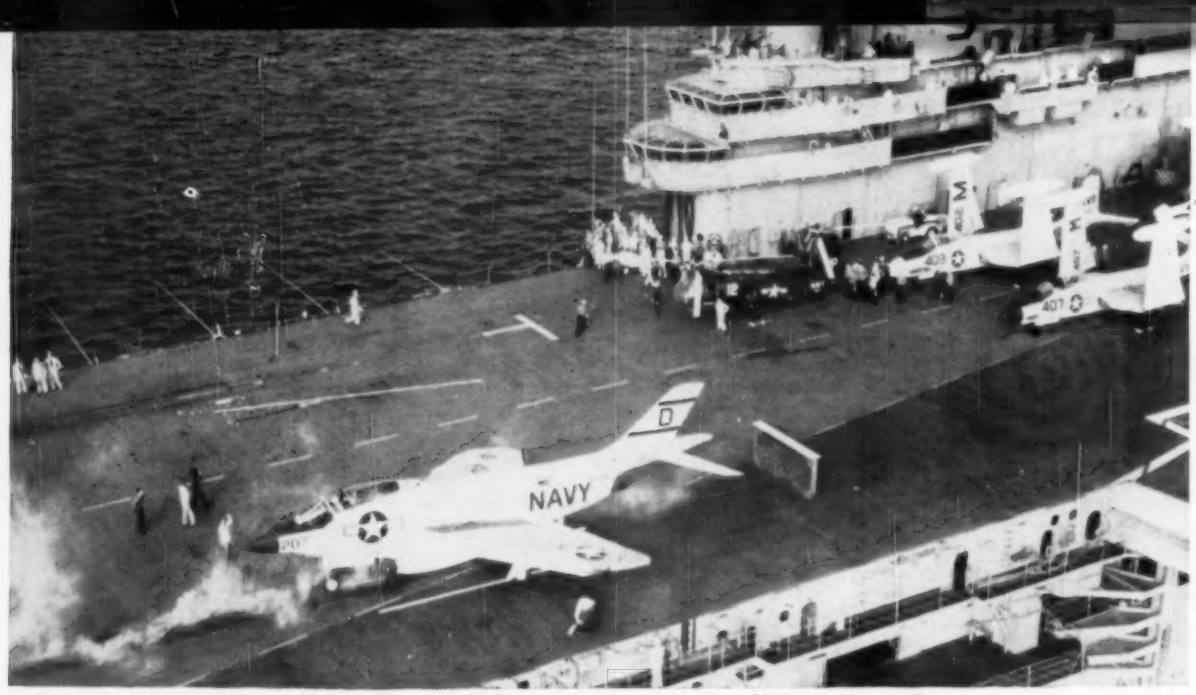
• **General Electric Trophy,** to Strategic Air Command's 22nd Bomb Wing, March Air Force Base, Riverside, Calif. A crew headed by Maj. Joseph Schrieber flew a Boeing B-47 Stratojet 1,900 miles from Kindley AFB, Bermuda, to Oklahoma City at an average speed of 601.187 mph., a new record. They defeated B-47 crews from the 301st Bomb Wing, Barksdale AFB, Shreveport, La., and the 310th Bomb Wing, Smokey Hill AFB, Salina, Kan.

• **Allison Trophy,** to a ground crew from Webb AFB, Tex., headed by S/Sgt. Eugene F. Bleckler. The crew changed the Allison J33 turbojet engine in a Lockheed T-33 trainer in eight min., 18.8 seconds as compared with the 11 min., 32.2 sec. with which the Webb team won last year's event. They defeated three other Air Training Command crews from Laughlin AFB, Tex., Greenville AFB, Miss., and Laredo AFB, Tex.

• **North American Trophy,** to Lt. (j.g.) David K. Grosshuesch of Navy Fighter Squadron VF-24, Moffett Field, Calif., who flew a North American FJ-3 Fury from the carrier USS Shangri-La off the northern coast of Mexico to Oklahoma City, a distance of 1,198 miles, in two hrs., 13 min., 38.6 sec. for an average speed of 537.849 mph. He defeated three other Furies from the same squadron.

• **McDonnell Trophy,** to Lt. (j.g.) Ralph Carson of Navy Fighter Squadron 124, NAS Miramar, Calif., who flew a McDonnell F3H-2N Demon from the Shangri-La off San Francisco, Calif., a distance of 1,436 miles, in two hrs., 32 min., 13.45 sec. for an average speed of 566.007. Two of four entries failed to complete the event.

• **Douglas Trophy,** to Capt. J. T. Blackburn of Navy Heavy Attack Squadron 1, NAS Jacksonville, Fla., who flew a Douglas A3D Skywarrior from the Shangri-La off the coast of Oregon, a distance of 1,543.3 miles in two hrs., 32 min., 39.7 sec. for an average speed of 606.557 mph. He defeated another A3D and two Douglas A4D Skyhawks, all of which took off from the Shangri-La.



McDONNELL DEMON is launched from Navy carrier Shangri-La for speed run to National Aircraft Show.

static display aircraft and components.

The three new trophies may be continued, depending upon what aircraft are in use in future years. Franklin said McDonnell particularly wanted a permanent award event.

Even Break Financially

Franklin said he expected "fairly close to an even break" financially. He compared the show to those in Dayton, rather than Philadelphia, pointing out that Oklahoma City is closer to Dayton in size.

He said cooperation from the Oklahoma City Chamber of Commerce, co-sponsor of the Aircraft Show with the Air Foundation, was "the best we've ever had. They did far more than their share."

It will be some time before the site for next year's show is selected, but Franklin said Houston, Minneapolis-St. Paul, New York City, Atlanta and Oklahoma City all have shown a great deal of interest.

Significance Tarnished

Significance and glamor traditionally attached to the Thompson Trophy proved badly tarnished at Oklahoma City because the Defense Department would not allow a genuine attack on the speed record.

Pilot of the Navy's F8U Crusader, Cmdr. Richard (Duke) Windsor, had orders to break the existing record for the Thompson but to go no further.

USAF's flyby of the Lockheed F-104, a much faster airplane than the F8U, helped point up the artificiality of this year's Thompson event. On top of this, some Navy spokesmen tried to deny that the F8U was being held back at all, citing the fact that the record was made without waiting for the most ideal wind and temperature conditions at the China Lake, Calif., course.

The USAF had a similar paradox in the case of its F-100C that won the Bendix trophy with an average speed of 666.661 mph. Another USAF plane, a Convair F-102A, flew the same course before the show at an average speed of 819.5 mph.

Foreign Attaches' Dinner

Oklahoma City—Lt. Gen. Clarence S. Irvine, deputy chief of staff for materiel, delivered the principal address before the annual dinner for foreign air attaches here on the eve of the National Aircraft Show. The dinner, jointly sponsored by the Aircraft Industries Assn. and Westinghouse Electric Corp., was attended by more than 50 air attaches representing 28 nations.

In his speech, Gen. Irvine warned that the USAF is ready to punish any act of aggression with atomic power, whether the war be full scale or limited. The general said that U. S. airpower, while dedicated to the preservation of peace, will be applied "instantly, globally and decisively" if aggression appears. At the same time, he expressed the hope that airpower will contribute to world goodwill by accelerating the pace of international trade and communications.

Sixty Firms Display at Air Show In Smallest Turnout Since 1953

By Evert Clark

Oklahoma City—Approximately 60 firms, the fewest in the last three years, were represented by static displays at the 1956 National Aircraft Show.

The exhibitors occupied some 20,000 sq. ft. in hangars at Will Rogers Field. Last year's show at Philadelphia had approximately 80 exhibitors, and the 1954 show in Dayton—home of USAF's Air Materiel Command—included some 90 exhibitors, occupying 60,000 sq. ft. In 1953, there were approximately 45 exhibitors at Dayton.

Ben Franklin, general manager of the show, said some companies apparently felt the Oklahoma location—midway between the coasts and in a relatively sparsely populated area—was too far to come.

Nevertheless, all major airframe companies and all but one major engine company were represented, Franklin said.

Air Force, Navy and Army exhibits occupied one hangar each, in addition to static displays of aircraft and equipment.

Like the aerial part of the show, the various military exhibits stressed each service's capability, with the Navy putting particular emphasis on its striking power.

Air Force aircraft included three Century series fighters—the North

American F-100 Super Sabre, McDonnell F-101 Voodoo and the Convair F-102, but the Lockheed F-104 Starfighter appeared only in fly-bys. The same was true of the Boeing B-52 bomber.

Navy aircraft included the record-breaking Chance Vought F8U Crusader, mounted on a revolving stand and roped off from the crowd. The Navy also exhibited its 15-ft. Dart supersonic tow target, its 12-ft. Rockair rocket used for exploring wind velocities and the Regulus I missile. Terrier surface-to-air and Sparrow air-to-air missiles were displayed only in mockups. The Air Force exhibited Hughes Falcon air-to-air missiles on a Northrop F-89H Scorpion, the intercontinental Northrop Snark, and an early model of the Martin Matador surface-to-surface missile.

The Air Force's hangar exhibit included a trainer used to teach Boeing factory mechanics and Air Force crews to operate the B-52 Stratofortress fuel and pneumatic systems. It also included a mockup of an Aerophysics Development Corp. hypersonic test vehicle made up of a seven-bottle booster with three fins and a four-bottle main body with four fins, plus a nose.

Turbine Engines

The Navy hangar exhibit included cutaway models of the Fairchild J44 and Westinghouse J34 turbine engines and a display illustrating the USN Medical Research Laboratory's experimental work with a new color for survival gear —fluorescent orange-scarlet, which can be seen easier at great distances than the standard yellow survival gear color.

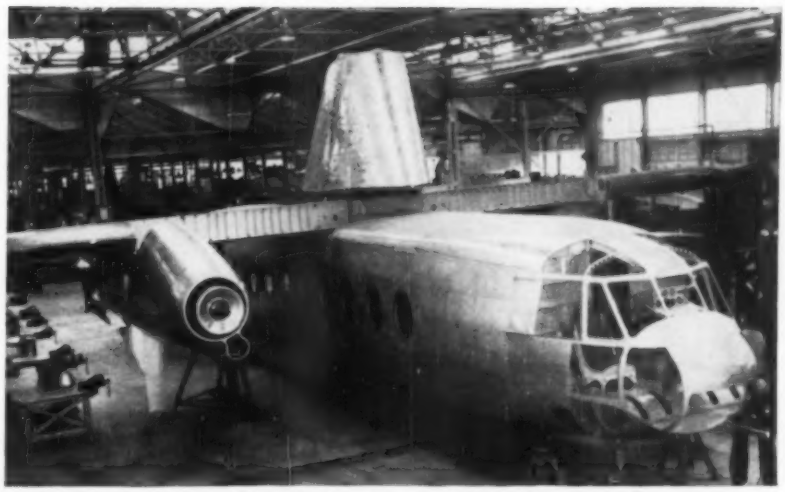
Army's hangar exhibit included models of experimental rubber and nylon droppable water/gasoline tanks that can be thrown from an aircraft without a parachute. Called "Flying Saucers," they are shaped much like the popular conception of a saucer. Another exhibit illustrated Army Quartermaster Corps. experimental work with paperboard honeycomb shock absorbers that are used as "cushions" for air-dropped equipment.

Using these to absorb the shock of a drop, the Army can replace 100-ft. parachutes with much smaller, cheaper stabilizing canopies.

In recent tests at Ft. Lee, Va., 1,000-lb. loads of operational rations in cans were dropped from 1,500 ft.—using shock absorbers and only a 15-ft. stabilizer parachute—without damage. A Quartermaster Corps spokesman said it is now possible to drop rations cushioned by paperboard absorbers "without even breaking the cookies in the can."

Reactor Avionics

Development of avionic components and circuits that have been able to operate successfully for 1,000 hr. in a nuclear reactor, where they were subjected to 450C temperatures and neutron flux densities of 1×10^{12} neutrons per sq. cm. per sec., will be officially revealed this week by General Electric. For additional details on this significant avionic development, see p. 112.



Combination Aircraft

Fairey Rotodyne, 44-passenger aircraft combining helicopter and autogyro characteristics, nears completion. Powerplants are a pair of Napier Eland gas turbines, driving propellers for forward flight and supplying air to tip jets with afterburners for takeoff. Design speed is better than 150 mph. Main rotor is unloaded during forward cruising flight.

Arnold Puts Mach 15 Tunnel in Operation

Mach 15 electrical discharge tunnel is operating at the Arnold Engineering Development Center of the USAF Air Research and Development Command, Tullahoma, Tenn.

Hot Shot, as the tunnel is called, currently is giving several shots per day with true temperature simulation (15,000F at 11,000 mph.) for nose cone investigations of ICBMs and post-Century series weapons. It officially will be available to the armed services and private contractors within the next few months.

A blow-down rather than a shock tube type of hypersonic tunnel, Hot Shot stems from a contract to ARO, Inc., Air Force operating contractor at Arnold, to build the Air Force's "highest speed" wind tunnel. It is based upon research done by ARO, Cornell University, Ithaca, N. Y., and Cornell Aeronautical Laboratory, Buffalo, N. Y.

Electricity stored in a roomful of capacitors is discharged across the air inside a small vault (about the size of a wall safe) upstream of the tunnel's nozzle. This million-ampere explosion creates 20,000 psi. pressures, bursts a thin plastic diaphragm and expands through a $\frac{1}{8}$ in. hole into the five-foot diverging nozzle. Here it accelerates, impinging 1,000 mph. flow upon one of the hand-sized steel models in the 16 in. test section.

Although the flow only lasts about 10 milliseconds, there is enough "steady-state" before the explosion debris begins to sail past the model to permit high-speed recorders to document the run. Dr. Robert Perry, director, feels that Hot Shot's most significant achievement is its run duration as compared with the shock-tube types of hypersonic facilities.

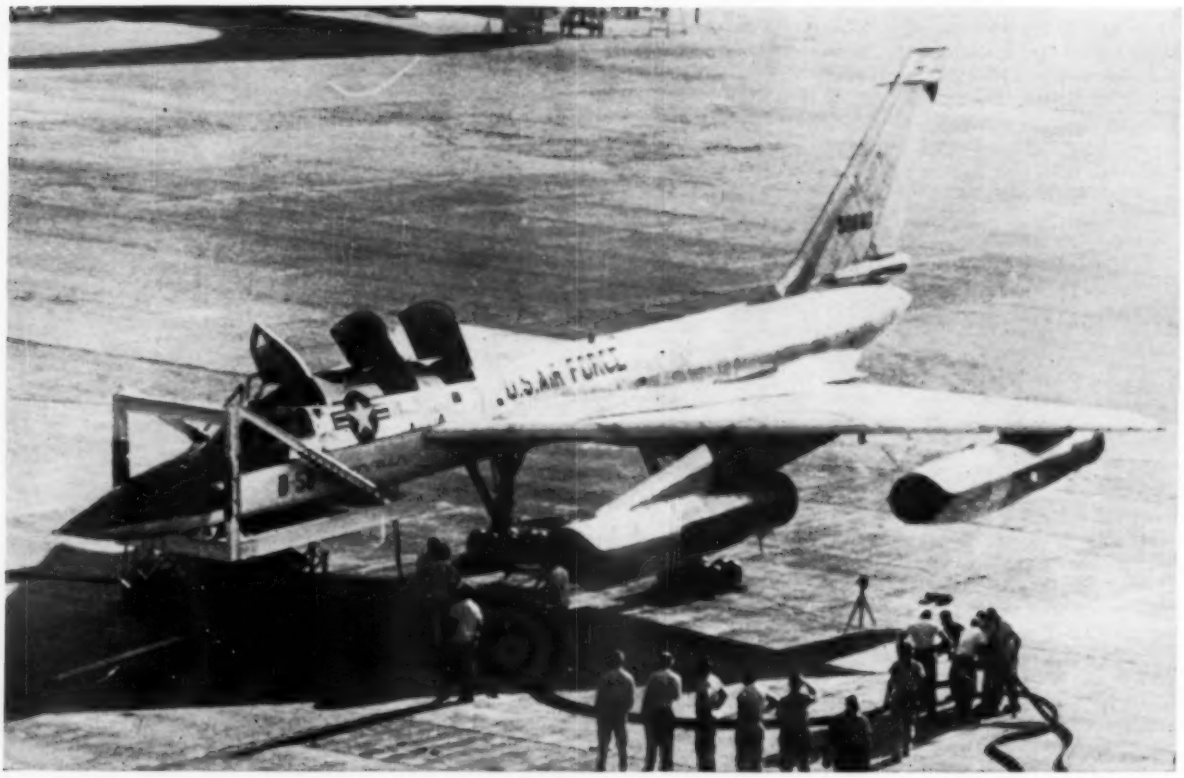
Before the runs, pumps charge the vault with air and evacuate the nozzle and test area downstream from the diaphragm.

ARDC Acquires Plant For Shielding Research

Baltimore—Air Research and Development Command has acquired the use of a new facility and new personnel in its search for a nuclear shielding material light enough to use in the USAF's atomic-powered WS-125A bomber.

The Air Force has signed a contract with the Atomic Energy Commission making the nuclear shielding facility at AEC's Brookhaven National Laboratory at Upton, Long Island, N. Y., available for a long-term research program.

The facility consists of a "lid tank" set in the concrete shielding on top of a graphite and uranium reactor. Test materials and measuring instruments can be moved by remote control.



B-58 Hustler

Convair B-58 is rolled to engine run-up area at company's Ft. Worth plant. Aircraft shown is a portion of the complete B-58 weapons system, which includes a variety of packs slung underneath the fuselage. Podded powerplants are GE J79 turbojets, located to help make configuration conform to area rule design principles. System can deliver nuclear weapons and launch missiles.

P & W Maps Detail Of Florida Plant

East Hartford, Conn.—Pratt & Whitney Aircraft Division of United Aircraft Corp. announced last week that arrangements are "practically completed" for construction of a $42 million auxiliary aircraft engine-facility located in Palm Beach County, Fla. (AW Aug. 13, p. 33).

Florida Gov. Leroy Collins has signed an agreement reserving approximately 7,000 acres of the J. W. Corbett Wildlife Preserve for the Pratt & Whitney plant.

In exchange, Pratt & Whitney has purchased 9,000 acres bordering the preserve which it will give to the state for enlargement of Corbett.

The division said its Connecticut facilities, now manned by more than 37,000 employes, "are approaching the saturation point, and the advanced engines of the next aircraft generation can be more safely and comfortably brought through in a relatively remote, uninhabited area."

Wright A. Parkins, Pratt & Whitney, general manager said that approximately 2,000 engineers, scientists and technical personnel in jet engine design, test and development will be required at the Florida facility and that "several thousand" workers will be hired when production begins. Actual construction will begin as soon as an access road to the area is completed.

Army Names Four Firms In Turbine Engine Study

Washington—Four engine manufacturers have tackled the job of developing an improved small gas turbine engine suitable for helicopters, flying platforms, STOL and VTOL aircraft.

Army design study contracts have been awarded to Continental Aviation and Engineering Corp., Detroit ($52,308); Lycoming Division, Avco Manufacturing Corp., Stratford, Conn., ($59,113); Studebaker-Packard Corp., Detroit ($57,690), and the Turbomotor Division of Curtiss-Wright, Hempstead, N. Y. ($50,085).

The firms will place the emphasis upon low fuel consumption, simplicity of design, ruggedness, reliability and ease of maintenance. Operating positions from below horizontal to vertical must be considered to adapt the power unit for VTOL planes.

News Digest

First production order for Martin P6M SeaMaster jet flying boats has been awarded by the Navy. Total value, including spares and special tools, is $121,422,478. First SeaMaster was lost during an early test flight over Chesapeake Bay. Second prototype is now undergoing test.

Westinghouse Electric Corp. will make the powerplant for the Navy's first atomic powered surface ship, a light cruiser armed with guided missiles. Ship will be built by Bethlehem Steel at Quincy, Mass. Westinghouse contract is for $18.3 million.

Douglas X-3 research aircraft is no longer in flight status with NACA. Following removal of 1,200 lb. of equipment, it was returned to Air Force for disposition. Because of limited thrust of Westinghouse J34-WE-17 engines available when X-3 was completed, craft designed for Mach 2 probing was utilized primarily for research in the transonic and low supersonic speed range.

Just between us...

Even a child's whispered secret can be heard in Convair's new METROPOLITAN 440—the quietest passenger cabin of any airliner flying today!

New noise suppression techniques developed by Convair and leading acoustics consultants have given the Metropolitan 440 the quietest passenger cabin of any airliner flying today! In addition, the new Metropolitan 440 offers you more luxury! More speed! And all of the qualities of passenger comfort and dependability that have made the Convair first choice throughout the world.

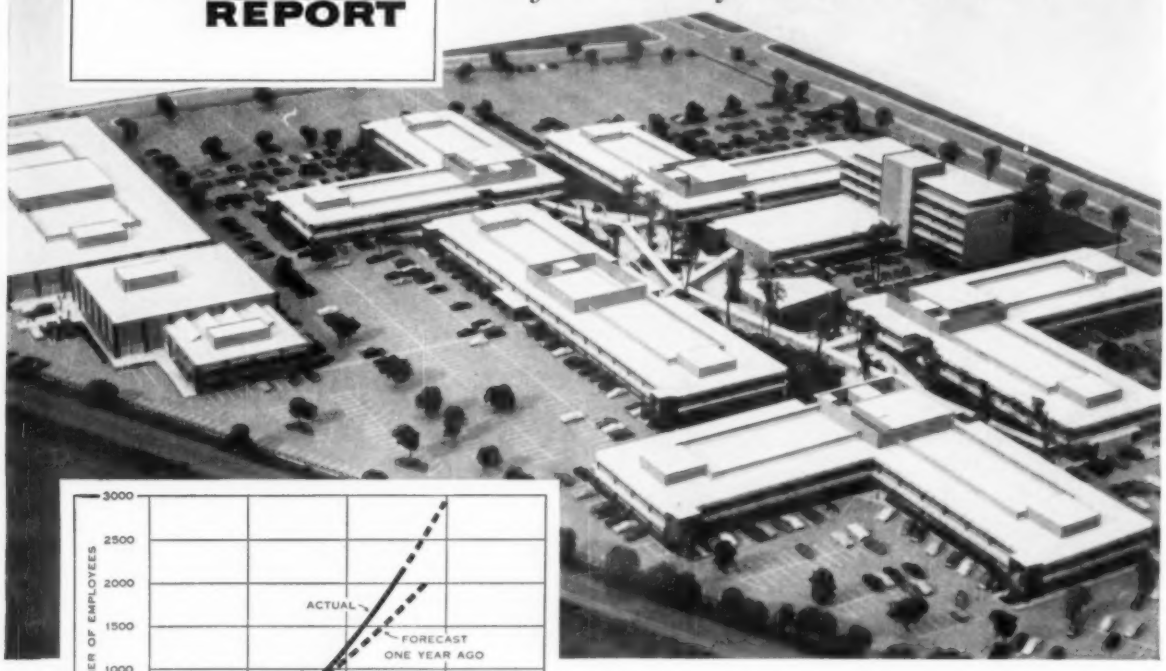
CONVAIR

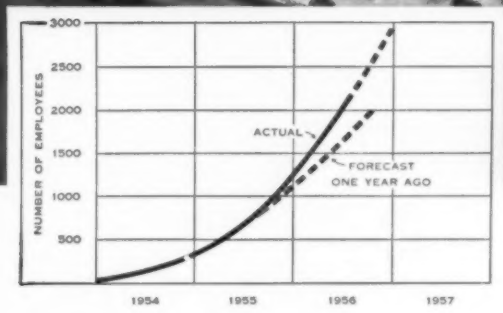
A DIVISION OF GENERAL DYNAMICS CORPORATION

Now Flying: SAS, Denmark, Norway, Sweden; SWISSAIR, Switzerland; SABENA, Belgium; AERO O/Y, Finland; CONTINENTAL, U.S.A.; DELTA, U.S.A.; NATIONAL, U.S.A.; REAL S.A., Brazil · ***Soon to Fly:*** ALITALIA, Italy; ANSETT, Australia; BRANIFF, U.S.A.; EASTERN, U.S.A.; IBERIA, Spain; JAT, Jugoslavia; LUFTHANSA, Germany; NIPPERI, Japan

PROGRESS REPORT

After Thirty-Four Months...





RESEARCH AND DEVELOPMENT PERSONNEL The above curve shows the growth in Ramo-Wooldridge personnel which has taken place since our Progress Report one year ago. A significant aspect of this growth is the increase in our professional staff which today is made up of 135 Ph.D's, 200 M.S's and 265 B.S's or B.A's. Members of the staff average approximately ten years' experience.

FACILITIES Within the past few months, construction has been completed at our Arbor Vitae complex, which now consists of eight modern buildings of 350,000 square feet, four of which are illustrated at the bottom of the page. Nearby is the R-W flight test facility, including hangar, shop, and laboratories, located on a 7-acre plot at International Airport.

To provide additional space for our continuing growth, construction has been started on an entirely new 40-acre Research and Development Center, located three miles from the Arbor Vitae buildings. The photograph above is of a model of the Center, which we believe will be one of the finest research and development facilities in the country. The first three buildings, now under construction, will total 250,000 square feet.

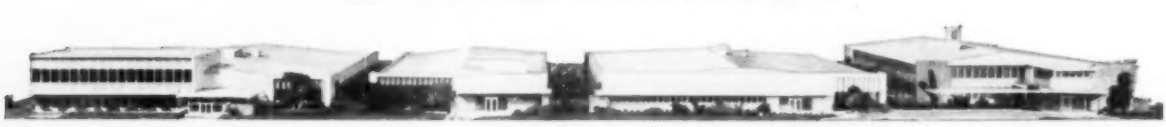
A second major construction program is underway on a manufacturing plant for quantity production of electronic systems. The initial unit of the plant, located on a 640-acre site in suburban Denver, Colorado, will be completed next spring and will contain approximately 150,000 square feet.

PROJECTS Our current military contracts support a broad range of advanced work in the fields of modern communications, digital computing and data-processing, fire control systems, instrumentation and test equipment. In the guided missile field, Ramo-Wooldridge has technical direction and systems engineering responsibility for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. Our commercial contracts are in the fields of operations research, automation, and data processing. All this development work is strengthened by a supporting program of basic electronic and aeronautical research.

THE FUTURE *As we look back on our first three years of corporate history, we find much to be grateful for. A wide variety of technically challenging contracts have come to us from the military services and from business and industry. We have been fortunate in the men and women who have chosen to join us in the adventure of building a company. We are especially happy about the six hundred scientists and engineers who have associated themselves with R-W. Their talents constitute the really essential ingredient of our operations. We plan to keep firmly in mind the fact that the continued success of The Ramo-Wooldridge Corporation depends on our maintaining an organizational pattern, a professional environment, and methods of operating the company that are unusually well suited to the special needs of the professional scientist and engineer.*

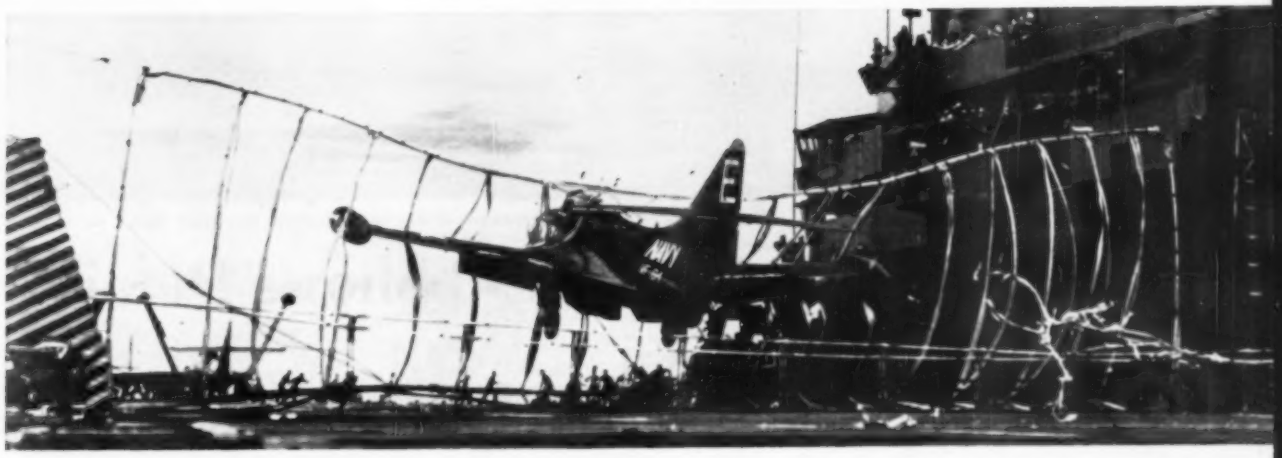
The Ramo-Wooldridge Corporation

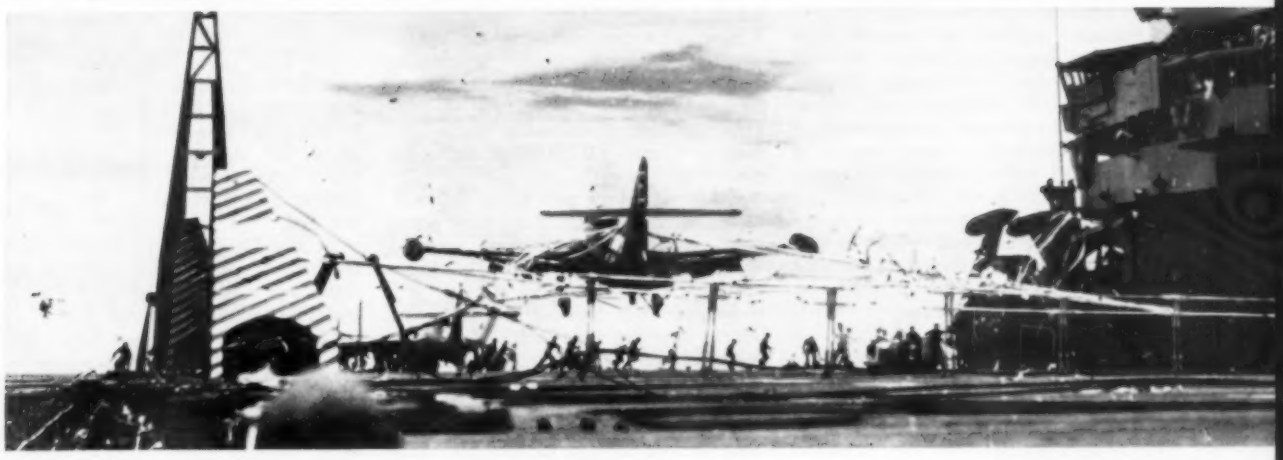
5730 ARBOR VITAE ST. • LOS ANGELES 45, CALIF.

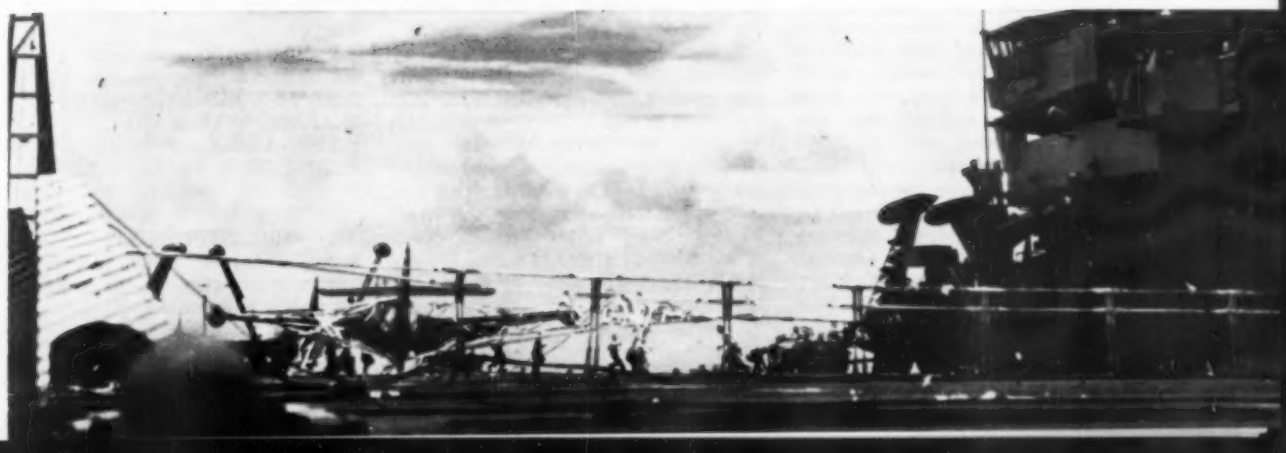


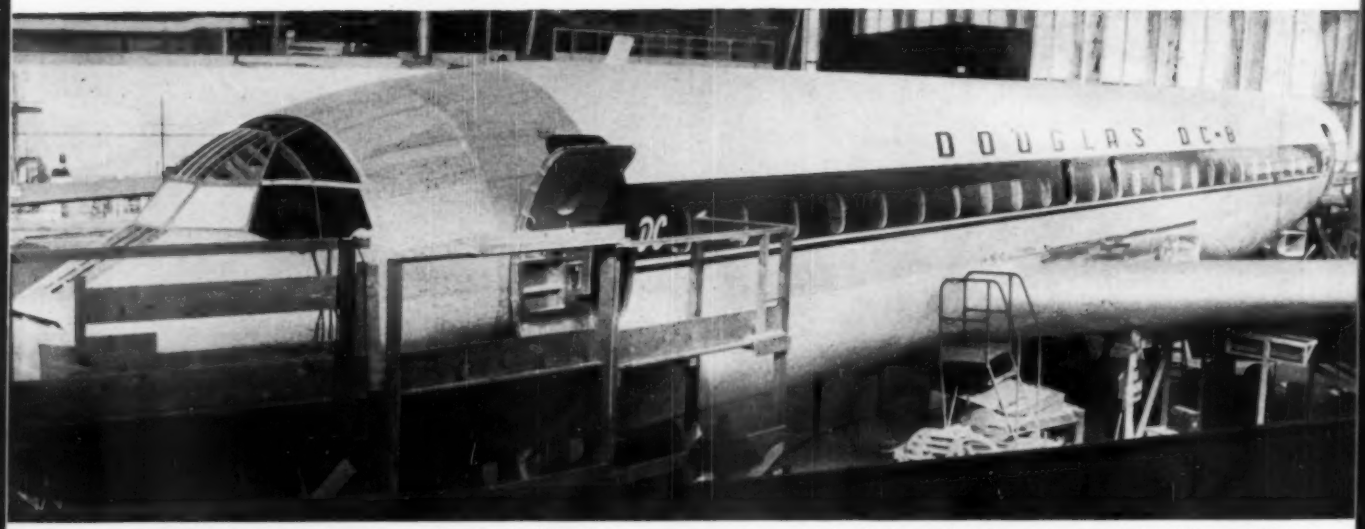
Davis Barrier Halts F9F Safely

Davis barrier and barricade aboard the attack carrier Lake Champlain halt an F9F-5 of Fighter Squadron 84 with minimum damage to plane. When hook missed arresting wire (right) fighter bounded over lower barrier, but was enmeshed tail-down in higher barricade. Plane spotted on deck forward was not damaged and running crewmen escaped injury.









DOUGLAS DC-8 engineering mockup is valuable aid to company engineers in developing and trying out many design ideas and details

Mockup of Douglas DC-8 Shows Details of

By Richard Sweeney

Santa Monica, Calif.—New design features of the Douglas DC-8 were shown on the engineering mockup of the big jet transport during the company's annual open house last week.

Features outlined by Project Engineer Ivar Shogran included:

• **Engine pylons** with double camber, tailored to help produce desired airflow at both inboard and outboard pylon stations. Camber is easily visible in the inboard pylons, not so noticeable but still present in the outboard pylons.

• **Engine bleed** air lines will be cooled to a maximum 450F at any point. Reduced efficiency, Shogran says, will be more than offset by increased safety in wet wings.

• **Control cables** were laid out in the wings first, in lines as straight as possible, reducing stress and permitting smaller cable diameters. Fuel, air and other lines were then designed into the wing structure.

• **Engines** will be interchangeable on pylons. In addition, changeovers from J57 to J75 or Conway engines will not affect pylons. Power packages all fit onto same pylon, cutting cost if an airline decides to convert from one powerplant to another.

• **Flight** controls are aimed at good control during wing-low approaches in cross winds. Douglas says airlines have asked for this feature, hope to standardize on this approach and eliminate crab to correct for cross winds.

• **Elimination** of all accessories from engine fronts, installing them under or to the rear of engines, thus reducing chance of tools or materiel being left in air intakes. Foreign object damage, the Air Force has found, is the biggest single cause of engine changes before normal operating time limits are reached.

• **New crew compartment** air conditioning philosophy, aimed at cooling avionic gear as well as crew members. System will eliminate drafts on aircrew members, increasing their efficiency, keeping them cool or warm according to needs.

• **Cabin air source** will be in the nose to lessen or eliminate chances of odors from engines being picked up and introduced into passenger compartment.

Shogran said locating the cabin air source near the nose yields cleaner air for passengers. Since engine bleed air will be used to keep windshields clear of snow, ice and rain, it also will drive the air-conditioning compressor turbine located outside the pressure hull, thus getting double use of the plumbing lines which carry the air forward.

Larger than usual airplane windows are used. They are located 40 in. apart. The guiding philosophy has been that the more parent material used in the structure, the better, Shogran said. DC-8 cabin structure thus will be more lightly loaded than similar types, but still will be stronger along the usual 37 deg. plane where bending loads occur, Shogran stated.

The DC-8 will use a double-slotted flap, running from wing-fuselage fillet to the inboard aileron. A hinged section will fold upward to allow engine exhaust to pass.

The oil cooler intake, located on the lower lip of the front cowl, will cause a slight airspeed penalty. But this will be more than offset by the fact that this accessory will be located where chances are remote that mechanics would leave tools, nuts, bolts or other material in the main air intakes, causing engine damage. In addition the Douglas-designed "blowaway jet" (AW Aug. 20 p. 41), destroys the intake vortex which sucks foreign objects from the runway and the taxiway during start and taxi.

In the DC-8 flight control system, the inboard ailerons and rudder will be full-power operated by a 3,000 psi. hydraulic system. Should power fail, in both cases there are direct cable links to aerodynamic tabs which will insure full control at low speeds.

The power-operated inboard ailerons are torque linked to the outboard surfaces, making both surfaces effective at low airspeeds. At higher Mach numbers (above Mach .85) the torque link cuts out the outboard ailerons, leaving the inboard ones effective and eliminating aileron reversal at higher speeds (up to Mach .95).

The elevators are aerodynamic tab actuated. Full movable stabilizers are hydraulically operated. In addition, there is an electrical secondary system behind the hydraulics (in case of hydraulic failure) which also permits smaller increments of movement, giving finer pitch trim adjustments.

In the crew compartment cooling

for the new transport.

New Design

philosophy, Douglas is making provisions whereby colder-than-normal air will enter the cabin, first cool avionic gear on the radio rack, then circulate in the cabin generally. Other air-conditioning outlets have been located to keep direct air drafts off crew members while providing adequate cooling. In addition, the system provides for better smoke evacuation and other emergency situations.

Studies have been made of the possibility of the front-gear bow wave throwing foreign objects from wet runways into air intakes, and the front gear has been located to minimize this possibility. In addition, Shogran says a small mudguard of some type may be incorporated to insure that no foreign objects enter the intakes from the front wheels.

The three airfoil profiles of the DC-8, a controversial subject, were adopted to achieve the most even stall characteristics and low speed handling features, and at the same time give good performance at high speeds. Much wind tunnel testing of the sections indicates that the section combination will work out as expected, Shogran said. In addition, in the thick root section where camber is greater on the underside than on top, space is provided for more fuel.

The airplane will have four electrical systems utilizing two independent alternators in case of electrical malfunction. Either of the two systems will sustain full electrical operations, while even one will retain enough power for emergency operations.

Aviation Groups End Long Dispute, Accept Vortac as Common System

By L. L. Doty

Washington—After six years of bitter wrangling, aviation factions last week unanimously agreed to accept Vortac as a common federal airways system.

The Air Coordinating Committee's decision to integrate the controversial Tacan with VOR and ILS under the name of Vortac (AW Sept. 3, p. 41) has met with no outward resistance and already plans are under way to implement the compromise program.

The Civil Aeronautics Administration, abandoning its long-time opposition to Tacan in the face of the ACC dictum, will begin immediately with the installation of 295 Vortac stations scheduled for use by 1959. Goal is for 1,087 stations in full operation by 1965.

Only the Airplane Owners and Pilots Assn. took exception to the ACC decision. The organization termed it a "dark chapter in the history of civil aviation" and a "major victory for the military and a major defeat for civil aviation."

Nevertheless, AOPA declared that it would accept Vortac and said it would "take whatever steps are necessary to help make the system work."

The Air Transport Assn., which once was cool to Tacan in any form, lent its full support to Vortac "in the interest of satisfying the special needs of the military services for the defense of the country."

ATA Stand

ATA stressed that VOR/ILS meets the requirements of the air transport industry, and added that military plans to install Tacan at certain sites for tactical needs would have interfered with the present airways system. It added:

"The effect of the plan (all Tacan), while satisfying defense requirements, would have been to compound the existing problem of our inadequate air traffic system."

The VOR/DME system was jointly planned and developed by both civil and military airspace users as a common system shortly after World War II. But with the advent of Tacan in 1947, the military took a strong stand against VOR/DME, terming it inadequate for its purposes.

In 1955, Air Force Secretary Donald Quarles took an unequivocal position in favor of Tacan and charged that the decision to install and equip the airways with VOR/DME was made solely by the CAA. Interestingly, the Defense Department in 1953 acceded to civil demands sufficiently to propose a system almost identical to Vortac, but the plan was not then acceptable to civil aviation authorities.

While not exuberant over the ACC decision, ATA is content to accept Vortac because of the urgent need for a single airways system. As a result, scheduled airlines are expected to take immediate steps toward modifying aircraft for installation of airborne Tacan-distance units.

Aircraft Modifications

Arinc specifications for wiring are expected to be completed within the next few weeks. First planes to be modified will be those on order, including jet transports. Fleets in operation will be retrofitted at a later date.

An ATA spokesman said airborne units should be available by autumn 1957 or early 1958. Units will cost in the neighborhood of $5,000 and weigh approximately 50 lb. Several manufacturers including Collins Radio, Bendix and Federal Telecommunications Laboratories have the airborne units in development for transports and light planes.

The ACC has given its assurance of governmental technical assistance in the development of low-cost, airborne Tacan-distance equipment for all users. In addition, the ACC Navigation Panel has been instructed to review all distance measuring requirements of general aviation and recommended appropriate additions for clear-channel DME ground environment.

The ATA is not "prejudging Tacan." Airlines will continue to study the feasibility of adopting the entire Tacan system for both azimuth and distance information while incorporating ILS facilities.

The ACC will make a decision regarding possible use of the ultra high frequency azimuth portion of Vortac for civil purposes after this element has been proved out through wide operational use by the military. About 25 Tacan units are currently in operation out of the 181 stations in varying stages of installation.

CAA officials believe Tacan installations scheduled for the future will include both azimuth and distance elements although some stations may not serve military aviation.

Cost of the Vortac program will

Airline Income and Expenses — 2nd Quarter 1956

(Dollar Amounts)

	Passenger Revenue	Mail Revenue	Express Revenue	Freight Revenue	Subsidy	Total Operating Income	Total Operating Expenses	Net Operating Income (before taxes)
DOMESTIC TRUNK								
American	$67,904,007	$1,648,881	$896,069	$3,424,299	.....	$74,815,481	$60,977,886	$13,837,595
Braniff	10,849,196	297,900	157,536	282,441	—$2,657	11,784,471	10,418,642	1,365,829
Capital	15,299,743	310,455	213,948	251,155	.....	16,284,217	15,742,997	514,220
Continental	4,047,399	103,653	36,965	109,078	233,911	4,647,388	4,269,420	377,968
Delta	15,938,395	381,580	265,320	470,757	.....	17,433,026	14,987,681	2,445,345
Eastern	50,472,684	918,797	458,803	635,441	.....	53,653,406	45,702,311	7,951,095
National	12,108,671	234,836	64,882	320,262	.....	13,387,388	10,670,736	2,716,652
Northeast	2,023,228	28,773	24,019	49,400	351,016	2,513,230	2,516,096	—2,866
Northwest	12,062,484	381,628	242,749	508,616	.....	13,411,368	12,409,495	1,001,873
Trans World	41,125,317	984,527	735,770	1,155,940	.....	44,663,575	44,839,622	—176,047
United	58,575,344	2,190,211	1,027,946	2,450,773	.....	65,704,006	56,901,191	8,802,815
Western	7,435,749	215,752	87,160	132,751	.....	7,964,571	6,855,020	1,109,551
INTERNATIONAL								
American	1,035,415	37,532	570	181,255	.....	1,304,481	1,180,206	124,275
Braniff	1,283,355	74,109	.....	74,001	267,652	1,781,802	1,650,306	131,496
Caribbean Atlantic	344,409	4,756	.....	11,284	.....	381,681	337,829	43,852
Delta	1,154,349	15,643	39,727	40,489	.....	1,251,554	1,172,521	79,033
Eastern	3,120,874	62,852	.....	47,582	.....	3,551,268	2,661,218	890,050
National	923,900	10,306	4,026	22,544	.....	997,407	960,399	37,008
Northwest	3,880,135	1,437,639	13,520	698,916	.....	6,364,931	5,838,428	526,503
Pan American								
Alaska	1,131,580	56,122	.....	250,569	335,068	2,051,639	1,864,385	187,254
Pacific	13,027,083	1,865,926	.....	1,447,132	115,570	17,663,829	15,445,132	2,218,697
Latin American	14,932,794	775,690	.....	2,449,290	1,510,972	21,322,307	20,981,385	340,922
Panagra	3,447,164	241,042	.....	366,531	.....	4,740,988	4,451,357	289,631
Trans World	15,396,680	1,089,063	.....	858,952	.....	18,948,491	18,001,461	947,030
United	3,472,359	110,940	.....	47,689	.....	3,742,794	2,736,354	1,006,440
LOCAL SERVICE								
Allegheny	1,200,335	23,074	31,165	11,966	398,736	1,691,345	1,762,793	—71,448
Bonanza	426,726	8,032	5,971	10,147	459,557	943,888	739,343	204,545
Central	299,326	9,776	3,494	8,972	506,709	833,498	823,222	10,276
Frontier	740,442	25,900	11,015	59,285	626,849	1,492,814	1,442,944	49,870
Lake Central	356,556	8,540	15,778	.....	320,180	707,293	664,258	43,035
Mohawk	1,180,970	14,881	11,200	19,943	149,195	1,420,917	1,412,400	8,517
North Central	1,593,553	47,099	37,005	.....	284,884	1,987,605	1,942,117	45,488
Ozark	821,915	25,355	18,965	14,420	693,713	1,589,133	1,391,769	197,364
Piedmont	1,298,303	25,506	17,440	16,946	320,521	1,784,115	1,902,695	—118,580
Southern	496,124	21,915	15,859	.....	382,596	942,464	972,957	—30,493
Southwest	763,947	25,664	8,768	10,898	233,352	1,103,602	1,206,441	—102,839
Trans Texas	752,991	27,126	13,109	24,348	566,697	1,401,201	1,425,696	—24,495
West Coast	561,394	9,770	4,768	9,915	394,082	999,836	969,382	30,454
HAWAIIAN								
Hawaiian	1,063,567	10,843	.....	184,179	58,724	1,404,213	1,299,213	105,000
Trans Pacific	487,780	1,746	.....	19,017	13,187	548,686	551,469	—2,783
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	438,516	.....	487,709	480,715	6,994
Flying Tiger	.....	19,237	10,463	2,037,069	.....	3,072,261	2,715,950	356,311
Slick	.....	41,995	13,075	1,709,227	.....	5,172,036	4,723,846	448,190
Riddle*	.....	18,105	30,626	940,493	.....	.....	.....	.....
Seaboard & Western	.....	.....	.....	.....	.....	5,540,720	4,697,399	843,321
HELICOPTER								
New York Airways	79,725	7,618	6,886	7,470	299,039	415,004	431,215	—16,211
Los Angeles Airways	23,585	34,927	24,892	.....	167,646	254,723	274,182	—19,459
Helicopter Air Service	.....	20,048	.....	.....	111,230	136,718	139,291	—2,573
ALASKAN								
Alaska Airlines	437,799	122,641	2,637	215,158	332,347	1,621,544	1,485,550	135,994
Alaska Coast	163,522	31,357	.....	19,794	90,977	342,368	289,799	52,568
Byers Airways*	.....	.....	.....	.....	.....	.....	.....	.....
Cordova	42,902	20,265	.....	25,220	64,763	358,990	333,049	25,940
Ellis Air Lines	122,048	14,737	.....	18,385	65,176	250,137	230,993	19,143
Northern Consolidated	186,675	77,403	1,079	116,367	174,047	848,336	755,060	93,275
Pacific Northern	1,501,701	139,319	.....	248,445	380,555	2,319,622	2,170,712	148,910
Reeve Aleutian*	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	173,455	131,341	.....	63,381	140,484	1,571,238	1,428,236	143,001

*Not available.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

reach $65 million by 1959, according to Commerce Undersecretary Louis Rothschild. Rothschild said civilian DME units to be discontinued cost the government approximately $1 million. The CAA, however, will study the possibility of converting present DME units to Tacan service.

Civil DME units will remain in operation until 1960 as a concession to the estimated 123 aircraft presently equipped with airborne DME. The CAA will establish a plan for the progressive decommissioning of civil DME stations after that date. The ACC said the government "will investigate the feasibility of replacing with Vortac/DME the airborne civil DME which has been purchased and installed in civil aircraft prior to August 30, 1956."

This phase of the program apparently mollified the National Business Aircraft Assn.

NBAA President Henry Boggess had violently opposed the Vortac program before the plan was announced.

Three days later, the NBAA did a complete about-face and sent Rothschild a telegram congratulating the ACC on its Vortac decision.

CAA Outlines Reorganization Plan

Washington—Reorganization of the Civil Aeronautics Administration establishing six principal program offices to execute CAA's over-all program was announced last week.

The reshuffling of departments, reported in AVIATION WEEK on Aug. 20 (p. 26), creates a direct line of responsibility from the directors of the new offices to administrator and deputy administrator.

Regional offices are also being reorganized to provide a regional counterpart of every headquarters officer. Thus any program requiring field action will be closely coordinated between the top level and the most remote CAA regional office.

The program offices established by the reorganization are:

• **Office of Air Traffic Control** that will be headed by D. D. Thomas, former deputy director of federal airways. H. S. Chandler has been named deputy to Thomas. The new office brings the air traffic control program to a policy level for the first time. The Office of Federal Airways is eliminated.

• **Office of Air Navigation Facilities.** An outgrowth of the Office of Federal Airways, Air Navigation Facilities will be headed by J. H. Tippets with Peter Caporale as deputy director. It will be charged with the responsibility of equipping and maintaining the airways while the ATC office will be concerned with airways operations.

• **Office of Flight Operations** and Airworthiness replaces the Office of Aviation Safety. Director will be W. B. Davis with Omer Welling as deputy. The department will be responsible for the examination, certification and inspection of aircraft operations, maintenance, design and manufacture.

• **Office of Airports** retains its original status with H. Howell and M. W. Hemphill continuing as director and deputy director. As in the past, the office will be responsible for the establishment of adequate airport facilities for civil aviation.

• **Office of International Cooperation,** replacing the International Region, will be charged with conducting CAA's relations with foreign governments. Functions of the three district offices have been transferred to the Office of Flight Operations and Airworthiness. Exact scope of the new office will be announced in about 30 days. Meanwhile, Anthony Callinan has been named acting director with former regional head F. C. Stone transferred to special assignments.

• **Technical Development Center.** No expansion of this technical research and development office in Indianapolis is anticipated, and the CAA has "no clear fix" as to the ultimate scope of its activities. Director is D. M. Stuart.

Activities of the six offices will be coordinated by a new Program Planning Office under the acting direction of William Barnes.

Public Relations and public information activities will be performed by the administrator's office with Ray Nathan as press and publications officer reporting directly to Deputy Administrator James Pyle. Ben Stern, former director of the office, has been placed on special assignment for aviation education.

The CAA will retain General Counsel's Office, Budget and Finance Office, Personnel Office and General Services Office, all under Sam Kemp, assistant administrator for administration.

Former Assistant Administrator Joseph Blatt is being transferred to New York as deputy regional administrator, and John Beardslee has been named regional administrator in CAA's Sixth Region at Honolulu.

The congressional liason post held by Albert Forte is being discontinued.

Charles J. Lowen

Charles J. Lowen, Administrator of Civil Aeronautics, died Sept. 5 of cancer in Denver, Colo. He had been ill since last May, when he underwent surgery in Washington.

Lowen, 41, became CAA chief in December following the controversial resignation of Fred Lee. Lowen had served as Deputy Administrator of Civil Aeronautics under Lee since July, 1955.

A 1938 graduate of the University of Colorado, Lowen worked in aviation sales and service until 1942 when he went on duty with the Air Transport Command. From 1945 to 1948, he was with Capital Airlines as Assistant Director of Domestic Operations and Director of Overseas Operations.

Lowen was Director of Aviation for Denver until 1951 when he went into the automobile business. He became Denver's Manager of Safety and Excise in 1954.

Pacific Northwest Case Reorganized by CAB

Washington—A study of local airline routes in the Pacific Northwest was divided by Civil Aeronautics Board last week into two new route cases—Pacific Northwest Local Service Case and the Montana Local Service Case.

The two new cases are among the first in a series of cases in which the CAB plans to review the entire local service route pattern. Two other local service cases already under way are the Seven States Area Investigation and the Great Lakes Area Investigation.

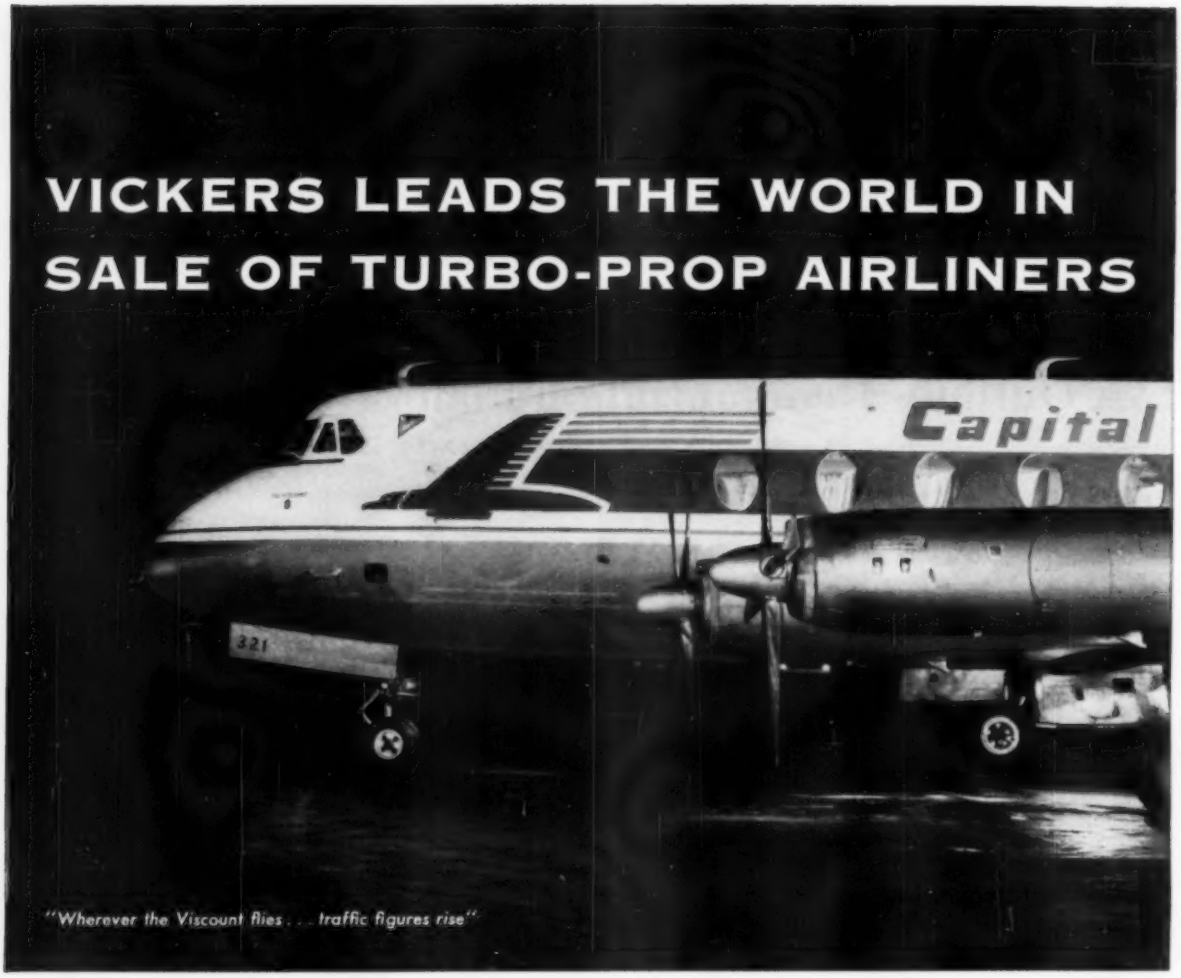
In launching the two cases, the CAB observed that proposed service from Spokane, Wash., to the East has little relationship to proposals for service west from Spokane, so the Board used a line between Spokane, Boise and Salt Lake City to separate the two route studies.

The Pacific Northwest Case includes applications of Bonanza Airlines, Southwest Airways and West Coast Airlines for new routes in an area that covers Washington and Oregon and parts of Idaho, California and Nevada.

The Montana Case, which covers Montana and points in Idaho, Washington, Utah, Wyoming, Colorado and North Dakota, includes applications from Frontier Airlines, West Coast Airlines and various communities and organizations in the area.

In the Montana Case, the CAB will study the question of skip-stop authority for the local airlines and will determine whether certain points should be dropped from the routes of United, Northwest and Western Air Lines.

VICKERS LEADS THE WORLD IN SALE OF TURBO-PROP AIRLINERS



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Vickers' pre-eminence in the field of turbo-prop airliners is securely rooted in the superiority of the Viscount. The world's first and only turbo-prop airliner in commercial service, the Viscount has demonstrated its power to make new traffic and speed records throughout the world. Passengers are exceptionally enthusiastic about the Viscount's freedom from noise and vibration, its luxurious comfort and the largest picture windows in any commercial aircraft. And airline operators have discovered that the Viscount's appeal to air travelers is paralleled by its unmatched economy and efficiency of operation.

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342 VISCOUNTS SOLD WORLD-WIDE AS OF AUGUST, 1956

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Trans-Canada Air Lines
British European Airways
Air France
Aer Lingus
Trans-Australia Airlines
Canadian Department of Transport
British West Indian Airways
Hunting-Clan Air Transport
Butler Air Transport
Iraqi Airways
Indian Airlines
Fred Olsen Airtransport
Misrair
Braathens S.A.F.E.
Central African Airways
Linea Aeropostal Venezolana
Pakistan Government
Hong Kong Airways
Union of Burma Airways
Iran Government
Indian Government
Compañia Cubana de Aviacion
British Overseas Airways Corporation
Philippine Air Lines
Hughes Tool Company (U.S.A.)
United States Steel Corporation
Standard Oil (California)

VISCOUNT 800 SERIES

British European Airways
K. L. M.
Transair Ltd.
Continental Airlines
New Zealand National Airways
Air Austria
Aer Lingus
South African Airways
Compañia Cubana de Aviacion
Trans-Australia Airlines
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Rail Fare Proposals Stimulate Further Passenger Shifts to Air

By Katherine Johnsen

Washington—The railroad industry may risk a major shift in its $200 million-a-year first-class passenger business to the airlines.

First concrete development in this direction was the petition filed by six railroads for a 45% hike in first-class fares. Interstate Commerce Commission has set Oct. 3 for a Washington hearing before ICC Examiner Oren G. Barber.

Airlines already have captured the lion's share of the first-class market. In 1955, the operating revenue of the domestic trunk and local-service carriers from first-class passenger business was $765 million. The railroads' first-class passenger revenue for the same year was $213 million, or less than one third.

The six rails applying for the sharp 45% boost had an operating revenue of $94.5 million from first-class passenger business, or almost half the $213 million total for the industry. The six lines, all operating in the New York-Pennsylvania-Ohio-Indiana-Illinois area, are: Chesapeake and Ohio Railway Co., New York Central Railroad Co., Norfolk and Western Railway Co., Pennsylvania Railroad Co., Pennsylvania-Reading Seashore Lines and Pittsburgh and Lake Erie Railroad Co.

Precipitous Decline

The decline of the railroads' first-class business over the past 10 years has been precipitous. From an operation of 19.8 billion first-class revenue passenger-miles in 1946, it dropped steadily and sharply to 6.4 billion in 1955. Meanwhile, the domestic airlines' first-class business rose from 5.9 billion revenue-miles in 1946 to 12.5 billion in 1955.

The 45% proposed increase would be a big stimulus for further shifts in first-class business to the airlines. The round-trip rail fare between New York and Chicago, for example, would be around $50 more than the air fare. At present, it is only about $10 more.

Huge deficits on over-all passenger service are forcing the rail industry into action. For the 10-year 1946-55 period, the passenger service net operating deficits totaled over $5.6 billion. The deficit mounted from $140 million in 1946 to $637 million in 1955. This reduced the rails' $1.8 billion net operating income on freight service in 1955 to less than $1.2 billion.

Reasoning behind the decision of the six petitioning railroads is twofold:

- **To put first-class service** on a paying basis—and if it cannot pay, let it go.
- **To try to hold onto medium-haul** coach service.

Modest Coach Increase

The six lines petitioned for an increase of only 5% in coach rates. In this, they were joined by two other rails: Lehigh Valley Railroad Co. and Reading Co. With this modest increase, rail coach fares would approximate air coach fares.

If the 45% increase in first-class fares is not approved, spokesmen for the petitioning roads warned, the carriers will be forced into a greater increase in coach fares to eliminate passenger service deficits.

Declaring that it is "imperative to take bold action to put our fare structure on a realistic basis," Alfred E. Perlman, president of New York Central, and James M. Symes, president of Pennsylvania Railroad, explained in a joint statement:

"A 5% increase in coach fares which we propose approximates the cost of providing the service . . .

"Meanwhile, we are trying to develop new passenger equipment which will reduce both first cost and maintenance costs for coach trains. Presently such new equipment is in experimental service. We and the equipment manufacturers are spending millions of dollars to develop the train of tomorrow. We are confident that these efforts will succeed and assure a large volume of rail travel in the future for moderate-distance coach trains. . . .

"In addition to recognizing this trend toward a wider base of mass travel, we feel that the coach traveler should not be penalized by the great losses sustained by our luxury accommodations. If fares for the Pullman service are not raised (the 45%), we necessarily will have to equalize some of the luxury class deficits by asking for greater increases on the coach or mass travel service."

Rails Hold Coach Market

The rails still hold the major portion of the coach market. Operating revenue from coach services (excluding commuter) in 1955 totalled $428 million, compared with $290 million for the scheduled domestic airlines. The railroads operated 17.3 billion revenue passenger-miles in coach service (excluding commuter) in 1955, compared with 6.7 billion by the scheduled airlines.

Despite the rapid growth of air coach

Proposed Rail Fares vs. Air Fares

FIRST-CLASS

(One Way Without 10% tax)

	Rail Pullman Fare (with lower berth)	Proposed Increase to:	First-Class Air Fare
New York-Washington	*13.14	*17.89	14.40
New York-Chicago	52.48	71.80	45.10
New York-Dayton	41.23	56.12	35.80
Chicago-Washington	45.13	61.43	37.80
Chicago-Dayton	*16.29	*20.10	16.05
Washington-Dayton	32.65	44.53	26.50
Washington-Detroit	35.01	47.59	27.30
Washington-Cleveland	25.65	34.76	20.80

COACH

(One Way, Without 10% Tax)

	Rail Coach Fare	Proposed Increase to:	Air Coach Fare
New York-Washington	7.96	8.29	11.00
New York-Chicago	32.25	33.86	33.00
New York-Dayton	24.91	26.15	27.00
Chicago-Washington	27.21	28.57	28.00
Chicago-Dayton	9.48	9.95	12.00
Washington-Dayton	19.85	20.84	20.00
Washington-Detroit	21.09	22.14	17.70
Washington-Cleveland	15.24	16.00	13.50

* With parlor seats.

PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA

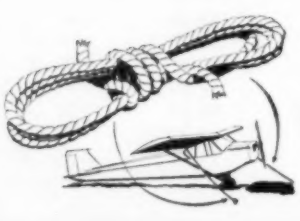
De-icing phone lines in the high Cascades

"Just like flying brooms!" That's what telephone men say about the Bell helicopters used to blow heavy frost from long-distance lines in Eastern Washington.

"Before they started using our 'copters," says Carl Brady of Economy Pest Control Company, Yakima, Washington, "men on foot had to try to clean the wires by hitting them with poles. Now, the downdraft from our ships does the whole job in a couple of hours.

"Flying around those wires can be tricky, but it's just another job to us. We do plenty of tough flying but we've never had a bad accident. Partly because of Chevron Aviation Gasoline 80/87. We use it in all our craft, and it gives us full power every time we need it. Never fouls plugs, either, and that's really something in a helicopter.

"Because of our government flying, we have to major every 600 hours. But using RPM Aviation Oils, we always take the extra 60 hours we're allowed, and even then the engines are perfectly good when we take them down. From what we've seen, 'RPM' would keep our engines in top shape for 900 hours. It's the best oil we can buy."



TIP OF THE MONTH

High winds with gusts are common this month in many areas. New ⅞" manila rope, double-stranded, will make a safe tie-down—don't risk your plane for the sake of an older piece of cordage.

CHEVRON AVIATION GASOLINE

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We take better care of your plane

T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U. S. PAT. OFF.

services over the past six years, railroad coach business has been fairly steady: from 17.4 billion revenue passenger-miles in 1950, it rose to 19.5 billion in 1951, to 19.7 billion in 1952, and dropped slightly to 18.9 billion in 1953, to 17.6 billion in 1954, and to 17.3 billion in 1955.

Meanwhile, scheduled air coach business mounted steadily—from 1.0 billion revenue passenger-miles in 1950 to 6.7 billion in 1955.

The eight rails seeking increases reported in their ICC petition that over the past 10 years their passenger service deficits have totaled over $1.2 billion (or about $125 million annually) and that 38% of the freight service income had to be utilized to offset these various losses. The petition said:

"Although rigorous measures have been instituted throughout this period to increase passenger revenues and to control passenger operating costs, including large investments in diesel motive power and modern equipment, mechanization of station work, reduction in station expenses, curtailment of unprofitable services, and incentive fares, the deficit in 1955 still amounted to over $126 million, and in that year it took 31% of the freight service net operating income to absorb this deficit.

"Although the year 1955 was a considerable improvement over many of the prior postwar years, petitioners have not been able to hold the 1955 gains in 1956. . . ."

Committee Attempts to Unsnarl International Air Legal Status

Washington—A group of aviation legal experts met in Geneva last week in an attempt to unsnarl an intricate international jurisdictional problem—the "Legal Status of Aircraft."

A Legal Subcommittee of the International Civil Aviation Organization convened at Geneva to try and find a solution to the problem of which national law applies to aircraft on international flights, a question lawyers have been trying to solve since 1912.

An international solution to the puzzle is important because it is needed to determine which law to apply when such things as births, deaths, crimes, marriages, conclusion of contracts and drawing up of wills occur on an aircraft in flight. National laws intended to clear up these matters are often contradictory.

Basically, the problem facing a judge in such a case is whether to apply the law of the state in which the aircraft is registered (the law of the flag) or the law of the state over whose territory the aircraft was flying at the time (territorial law).

Increase of transocean traffic adds another complication. Since no nation controls the high seas, there is no national law to apply unless ICAO decides to use the law of the nation where the aircraft is registered.

Varying national policies can complicate such a seemingly simple thing as a birth.

A child born on a Belgian airplane is considered a citizen of that country under Belgian law. British law claims a child born on a British airliner as a British subject.

But if a child were born in a British or Belgian plane over French territory, France would claim him as a citizen. And if the father should come from a third country, that nation might have a law claiming him.

Another variation would leave a child with no nationality. If he were born on a French aircraft flying over British territory, the French would consider him British and the British would consider him French, and it would be up to his parents to find him a nationality.

The same dilemmas occur with deaths, crimes and other legal problems. A further complication comes from the increasing speeds of modern aircraft. Occasionally it is impossible to decide which country an aircraft is over when a crime is committed if the action extends over a period of time and the aircraft crosses a frontier while it is being committed.

Air India International Orders Three Boeing 707s

Air India International ordered three Boeing 707 intercontinental transports last week for use on its international air routes.

Air India will use the 707 in a combination class configuration with accommodations for 90 tourist and 30 first-class passengers. Delivery is scheduled to begin in January 1960.

No engines have been specified for the turbojet transport, but Air India will probably choose the Rolls-Royce Conway over the Pratt & Whitney J75 because the Conway is a British Commonwealth product.

The Indian airline's 707 will have a nonstop range of 4,500 miles, cruise at 38,000 to 40,000 ft. and fly at 575 to 600 mph. The transport will allow Air India to operate a London-Bombay service in nine hours.

CAB Plans Stricter Flight Deck Rules

Washington—Civil Aeronautics Board plans stricter regulations regarding the admission of non-crew members to the flight deck of airline transports.

As the result of an ambiguity in present rules, the CAB is proposing an amendment of the Civil Air Regulations for domestic, international and irregular operations. The new rules will specifically prohibit any unauthorized person from entering the flight deck of an airplane.

Exceptions from the proposed prohibition include Civil Aeronautics Administration Aviation Safety Agents and CAB personnel on official business.

The pilot would be authorized to admit to the flight deck employes of the federal government, an airline or another aeronautical enterprise when their presence "is necessary or advantageous to the conduct of safe air carrier operations."

The Board also would give airline managements and the Civil Aeronautics Administrator authority to permit specific individuals to enter the flight deck.

Under the new regulations, a person admitted to the flight deck also would have to have a seat available for his use in the passenger compartment. Exceptions to this rule would include CAA Safety Agents, CAA and CAB personnel checking flight operations and air traffic controllers acting as observers.

Also exempted from the seat rule would be airline crew members, airline employes directly involved in flight operations and technical representatives of aircraft or component manufacturers conducting in-flight observations.

The new regulation gives the pilot in command specific authority to deny admittance to the flight deck to anyone not described in the list of exceptions. The pilot always has emergency authority to exclude anybody from the flight deck in the interest of safety.

Seven Viscounts Ordered By Trans-Canada, Indian

Additional Viscount orders totaling seven aircraft have been announced by Trans Canada Airlines and Indian Airlines Corp.

TCA's order of two more of the Vickers turboprops will raise to 38 the airline's fleet of Viscounts in service and on order. The new aircraft are expected by May 1958.

IAC, the Indian domestic airline, had five Viscount 700D series planes on order, now has ordered an additional five for delivery early in 1958.

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Use your Beechcraft Bonanza an average of 50 hours per month and your total cost of ownership and operation can be as low as 2½ cents per seat mile. Fly 30 hours per month (the average of all Bonanza owners) and your per seat mile cost is approximately 3¼ cents. *No other airplane* offers you so much for so little cost!

And here's what you get for your money: *The four-place Beechcraft Bonanza for '56 is the fastest, quietest, most rugged and most luxurious single-engine airplane on the market* — years ahead of others in its field.

Before you buy *any* airplane, get the facts from your Beechcraft distributor or write Beech Aircraft Corporation, Wichita 1, Kansas. You'll go *first class* and actually *save money* in a Beechcraft!

Beechcraft

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Shortlines

▶ **Braniff Airways** is offering an eight week, all-expenses tour of eight Latin American countries. The tour, designed for amateur and professional photographers, starts Oct. 7 from Miami. Its cost: $2,625.

▶ **Canadian Pacific Airlines** has been licensed by the Canadian Air Transport Board to extend service to Santiago, Chile. Route will continue to connect Toronto and Vancouver with Argentina via Mexico City and Lima, Peru, but Santiago will be added stop between Lima and Buenos Aires.

▶ **East-West Airlines** of Australia has cut its personnel 20% in an effort to offset financial losses caused by severe floods in areas the airline serves in New South Wales.

▶ **International Civil Aviation Organization** convened a Joint Support Conference in Geneva last week to revise existing Danish and Icelandic agreements providing for joint support of weather and navigation facilities at Iceland, Greenland and the Faeroe Islands.

▶ **Mohawk Airlines** has received the first of seven Convair 240 transports bought from Swissair. When the new airplane went into service last week, it brought Mohawk's fleet of pressurized transports to five Convair 240s.

▶ **Poland** has signed air agreements with Sweden, Yugoslavia, Austria and Belgium. The pacts call for reciprocal air service between the countries, and Poland is planning similar agreements with Britain and France.

▶ **Seaboard and Western Airlines** earned $415,997 after taxes in the first half as compared with $241,906 in the first half of 1955. Operating revenues for the first six months of this year were $9,148,000 as compared with $7,595,000 in 1955.

▶ **Trans-Australia Airlines** sold one of its Convair 240 transports to Trans Arabian Airways. Trans-Australia is disposing of its Convairs as part of a planned conversion to Viscount and Fokker F-27 equipment.

▶ **Trans World Airlines** reports that a baggage survey shows that passengers are receiving their luggage after a flight faster than ever before. Time lapse between leaving the plane and picking up luggage ranged from four minutes to ten minutes at the major air terminals studied.

AIRLINE OBSERVER

▶ Northeast Airlines' President George Gardner held serious discussions with Bristol officials last week concerning possible purchase of the Britannia. Gardner, said to be "very enthusiastic" about the turboprop transport, flew to London on Aug. 30 in the Britannia which was recently flown on a coast-to-coast demonstration tour of the U. S. Northeast is seeking equipment that will provide spectacular competition on the New York-Florida route against the luxury fleets of well-entrenched Eastern and National Airlines. Other U. S. companies which reportedly considered the Britannia are Braniff, Continental, Delta and Eastern. Managing Director Peter Masefield said he hoped sales of the Britannia in the U. S. would reach $200 million.

▶ **Trans-Canada is modifying its fleet of 18 Viscounts from 40-to-44 passenger configuration.**

▶ Airlines with heavy investments in turboprop and turbojet transports are watching Capital Airlines' financial returns closely as a clue to the potential earning power of a turbine-powered fleet. The Viscount has established itself operationally and maintenance-wise and has proved its ability to attract passengers. Now, with 31 Viscounts in operation, the airline is in a position to demonstrate its profit-making capacity. Route and service expansion expenses plus transitional costs, probable reason behind Capital's monthly net losses said to have stretched through August, may cloud the Viscount's true earning power.

▶ **Canadian government is building a new airport at Sault Ste. Marie, Ontario. The area has been served by Kinross Field at Sault Ste. Marie, Mich., requiring Canada-bound passengers to ride in bond in an airport bus to the Canadian border.**

▶ Boeing's small jet transport (AW Sept. 3, p. 26) will be designated Model 727. Powerplant currently considered for the aircraft is of Rolls-Royce make, although no details on model are known other than it is not a revision or modification of any current engine.

▶ **Braniff Airways was to have accepted delivery of its first DC-7C last week but, because of interior changes, delivery was delayed another week. Interior decor is predominately charcoal black and coral with black seat coverings.**

▶ British Overseas Airways Corp. has forecast that its transatlantic routes, which it hopes will ultimately connect the Pacific and Far East via the North American continent, will account for more than one half of its total business by 1961, according to Managing Director Basil Smallpiece. Smallpiece said, with the "right equipment" on the Atlantic route, BOAC will earn for England "in the early 1960s a net dollar revenue of some 30% per annum on the dollars we spend in buying aircraft."

▶ **Aeroflot is currently operating Beriev Be-6 flying boats in regular service. Resembling the Martin Mariner, the Be-6 (NATO code-name Madge) has a top speed of 258 mph., a range 3,045 miles and a gross weight of 51,590 lbs. Wing span is 108 ft. 3 in., power plants are two 2,000 hp. ASh-73 engines.**

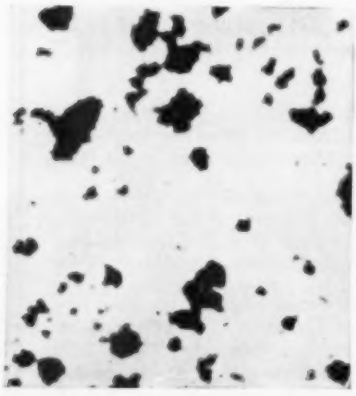
▶ Interest in the Whiting Loadair installation at New York International Airport (AW Aug. 13, p. 43) has died at least temporarily. The mechanical aircraft docking system will be removed sometime this month after a year's testing operation.

▶ **Pratt & Whitney J75 turbojet powerplants will cost about $250,000 as installed in the Douglas DC-8 jet transport. Cost of Rolls-Royce Conway bypass jet engines has not yet been determined.**

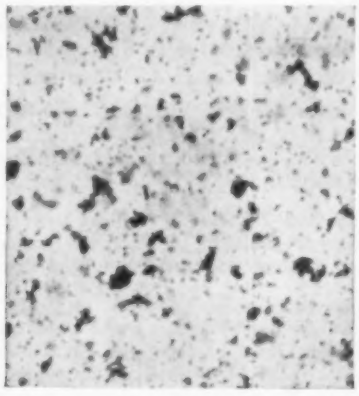
▶ Lacsa International Airlines, of Costa Rica, has received an offer from French interests to finance the purchase of Caravelle twin-jet transports. The offer, made through the French embassy in San Jose, Costa Rica, involves up to $10 million in long-term financing. Robert Smith, general manager of the airline, said that the proposal is being studied carefully although no conclusions have been reached. Lacsa also has under consideration the Convair 880 powered with "British turbojet engines."

SAFER BATTERY POWER

New GOX active material. Ultrafine particles give three times the surface area contact with electrolyte—boosts high rate capacity performance. Gives quicker response. Photomicrographs 400x magnification.



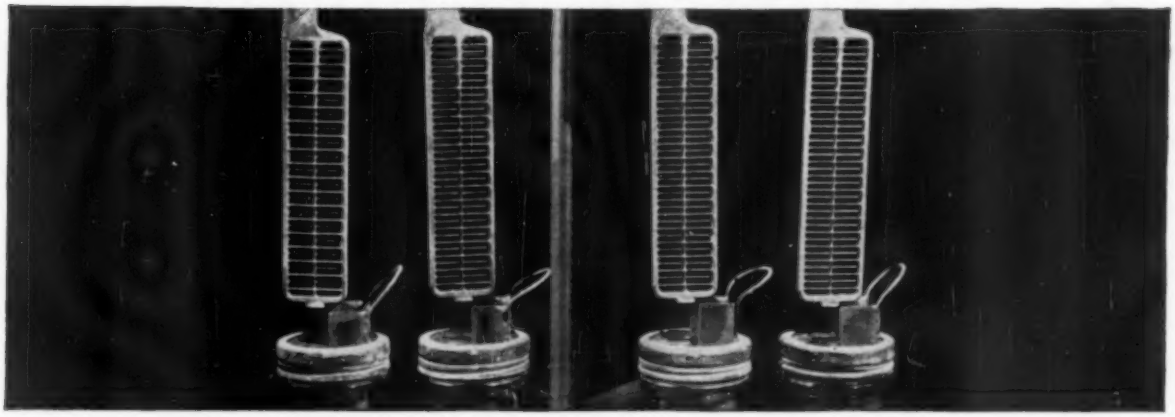
Ordinary active material.
Particles are coarse.



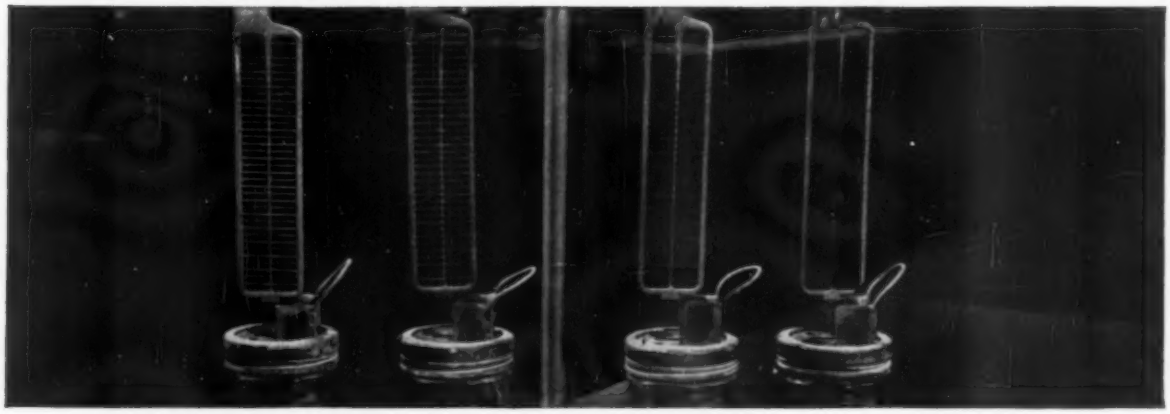
GOX active material.
Particles are fine.

New Pormax separators. 25% more porous. Pore size easily controlled. Electrolyte circulates more freely. Pormax separators are less subject to hardening with age.

New Silvium grids. Test proves Silvium resists corrosion better than any other commonly used grid alloy.



Before tests: Silvium alloy Alloy "A" Alloy "B" Alloy "C"



After tests: Note how the Silvium grid resisted corrosion. Compare it with other alloys.

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Exide announces new, greatly improved aviation batteries . . . safer against sudden failure, superior in capacity and life potential

With these new Exide Aviation Batteries, airlines can now practically forget the danger of sudden battery failure. Costly takeoff delays from unforeseen loss of battery power can be largely a thing of the past.

The reason lies in the new Silvium® alloy grid metal used in the positive plates of these batteries. This special alloy was developed by Exide to resist corrosion. And in aviation battery use, it prolongs grid life far beyond average battery life. Hence users have this extra measure of protection against grid failure—and against loss of electrical power. Silvium is used exclusively in Exide Batteries.

Protection like this is especially significant today because of the heavier electrical loads aviation batteries must carry. And it is especially valuable in long distance flights, where there's risk of repeated overcharging.

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The new Exide-developed GOX active material used in these batteries packs more power per ounce than the oxide formerly used. Finely ground oxide particles offer three times the surface area to the electrolyte that ordinary types of active material do. GOX means quicker response to sudden power demands.

Pormax separators add both quicker response to sudden power demands and longer life potential. Pormax is a new microporous plastic, 25% more porous with a more easily controllable pore size than the previously used rubber separators. It is also less subject to hardening with age.

See for yourself how much better battery performance these new Exide Aviation Batteries can give you. Call your nearby Exide sales office and ask for a demonstration. Batteries are available in four models covering a wide range of capacities. For descriptive catalog and technical details, write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pa.

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ALPA Urges New Instrument Panel

By Philip J. Klass

This week the Air Line Pilots Assn. will make a strong plea urging the Civil Aeronautics Board to adopt a new alternative to the standard instrument panel layout now required by the Civil Air Regulations (CAR) for new transport aircraft.

At the annual CAR review meeting in Washington, the ALPA will propose an instrument panel layout designed specifically around new integrated flight instruments which are slated to be used on up-coming airline jets and turboprops. The proposed panel is the overwhelming preference of ALPA pilot groups.

The present CAR panel was developed by the Cockpit Standardization Committee (S-7) of the Society of Automotive Engineers (SAE) at the request of the Air Transport Association and Civil Aeronautics Board.

ATA has surveyed its member airlines and is expected to report the result of its poll. At least two major airlines are believed to be favorably inclined to the ALPA-proposed panel while another is said to be strongly opposed.

How It Started

The proposed new panel layout is an outgrowth of independent studies by pilot groups set up by American and Eastern Air Lines to evaluate the several different integrated flight instruments available and recommend their preference. In the course of this study, both pilot groups found themselves involved in the question of the best panel location for such instruments. (The AA pilot group was headed by C. H. Daudt; the EAL group by Joseph Kelley.)

In their independent studies, both pilot groups came up with identical choices of integrated instruments as well as identical recommendations for their location on the panel. Both agreed that the two integrated instruments should occupy the prominent center location in the "basic six."

Because the pilot groups recommended panels which differed from the CAR/SAE standard, American Airlines asked ALPA to poll its members to determine their preference. ALPA's poll of its 52 councils produced a 51 to 1 vote in favor of the new panel over the CAR/SAE standard. (It should, however, be pointed out that in presenting the two panels for a vote, one was identified as an SAE design and the other as an "ALPA proposed standard," which may have influenced pilot voting.)

Despite the fact that the AA and EAL pilot groups were not aware of the new USAF instrument panel concepts, they came up with an arrangement which closely parallels the Air Force "crosshair" layout. This locates pitch axis instruments along a horizontal line, heading-azimuth displays along a vertical line. (AW July 23, p. 62; July 30, p. 48.)

Centered On Pilot

ALPA proposes to mount the combination artificial horizon/flight director and situation display (showing heading and bearing to a VOR or ILS localizer beam) almost directly in front of the pilot's seat centerline. (See sketch, p. 51).

The top row of instruments, left to right, include: airspeed indicator, horizon/flight director, altimeter, and rate of climb indicator. (The latter is not one of the "basic six.") The second row, left to right, includes: turn-and-bank, situation display, and radio magnetic indicator (RMI).

The present CAR/SAE standard actually consists of a basic panel layout plus three alternative arrangements, two of them intended to accommodate integrated flight instruments. The only similarity between the latter and the ALPA proposed layout is the location of the airspeed indicator in the top left corner. (See sketch, p. 51). The top row consists of the airspeed indicator, situation display, and horizon-flight director. The bottom row, left to right, includes altimeter, RMI, and rate-of-climb indicator. The turn-and-bank indicator is centered in the third row under the "basic six."

ALPA has proposed its new panel to SAE's S-7 committee, but so far has gotten a cool reception, officially. The committee, headed by M. G. (Dan) Beard, assistant vice president of American Airlines, was set up in 1950 to standardize cockpit instrument panel arrangements and other basic cockpit controls for both military and civil transport type aircraft.

The need for such action became apparent during the Korean airlift when it was found that the DC-4 aircraft requisitioned from the airlines had so many different cockpit configurations that flight crews required an extra hour or more of briefing on the particular cockpit they were going to fly that day, Beard says.

The S-7 committee, consisting of airline, military and airframe manufacturers representatives, formed three subcommittees to concentrate on cockpit controls, lighting, and instrument panels. The latter, also headed by Beard, consisted of eight members originally, later expanded to 10. Beard emphasizes that every member of this subcommittee was a pilot with an instrument rating and that one of the members represented the ALPA.

For more than two years this subcommittee analyzed a variety of different instrument panel configurations in close coordination with representatives of the Military Services and airframe manufacturers.

At one point the sub-committee was "about equally divided" between the present SAE standard panel and the crosshair arrangement which ALPA now proposes Beard told Aviation Week. The thing that swung the subcommittee to the present standard was a report by Navy and USAF aero-medical people which indicated that the human eye finds it easier to scan horizontally than vertically.

Heading Information

Based on the belief that heading information was more important than altitude, the SAE group concluded that the directional gyro or situation display should be located on the top row of instruments, displacing the altimeter to the second row.

ALPA disagrees. It points out that the most critical flight maneuver is an ILS approach at low minimums. Under such conditions the pilot relies primarily on three instruments: airspeed, horizon/flight director and altimeter. ALPA therefore believes these three instruments should be located side-by-side on the top row. This places them nearer the cockpit windshield through which the pilot will be looking for visual contact.

With the present CAR/SAE panel, the pilot must scan both vertically and horizontally, "skipping over" the directional gyro/situation display indicator.

The change which ALPA proposes comes at a time when the CAR/SAE instrument panel has just begun to come into use. Pan American Airways outfitted its new DC-7Cs with the standard panel. United Air Lines has allocated funds to modify its existing fleet to the new CAR/SAE panel, al-

though it is doubtful whether other airlines will follow suit.

The USAF and Navy, acting through the Aircrew Station Standardization Panel (ASSP), has adopted a standard panel which is similar, but not identical to the present CAR/SAE panel. It differs in that the turn-and-bank indicator is substituted for the ILS indicator in the center spot on the second row. Beard also reports that a number of business aircraft are now equipped with the CAR/SAE panel.

No Justification

After long, hard labors to develop the present panel and get it adopted by all interested military-civil groups, Beard is understandably reluctant to rush into a change now. When the SAE S-7 committee considered the ALPA proposal this spring it "searched for any basic reasons which would warrant changing the standard and considered whether principles improving safety and efficiency were involved." Beard says. On this basis, the committee failed to find any justification for a change or revision, Beard says.

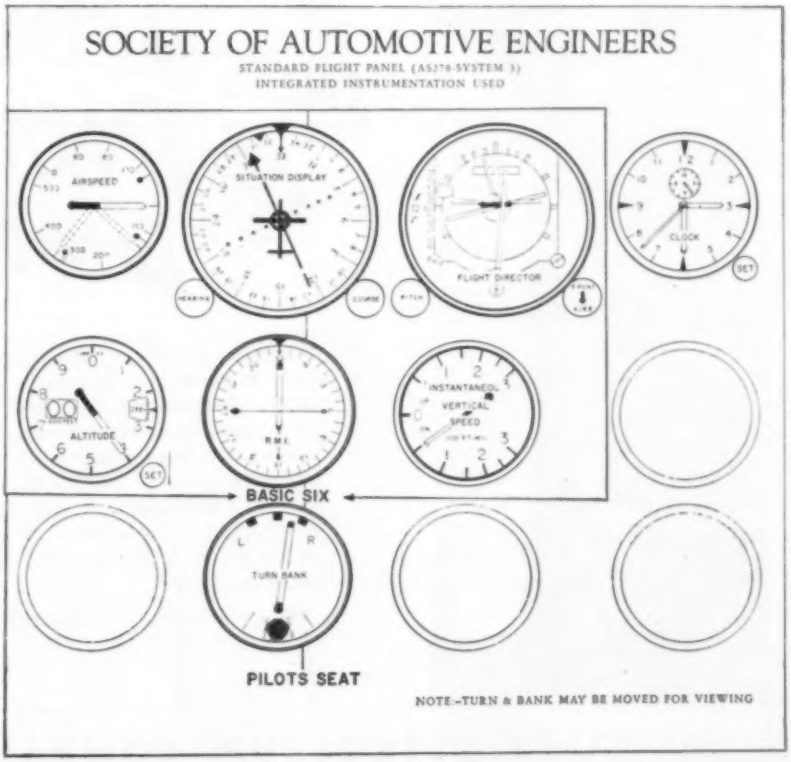
However, Beard does concede that eye motion studies, which played a major role in the present CAR/SAE panel arrangement, have not been conducted on the new integrated flight instruments. He adds that Committee S-7 is recommending that such studies be made to determine whether the basic principles of the horizontal relationship betwen the horizon and directional gyro should be changed when these two functions are integrated into dials which also display flight director and other information.

Beard says that S-7 maintains an "open mind" and is attempting to keep itself informed on the latest developments in cockpit panel instrumentation. For example, the committee has had a look at the Navy's newest development in cockpit displays which uses flat cathode ray tubes. The Air Force is scheduled to brief the group on its new integrated display philosophy in October.

ALPA Counters

ALPA representatives point out that at the time the present SAE standard was prepared, none of the airlines were using integrated flight instruments (except on an experimental basis) or had plans to do so. As a result, they claim, the SAE panel was designed primarily around the long-used conventional instruments.

The alternative panel arrangements which SAE adopted to permit the use of integrated flight instruments were based simply on a direct substitution of these new combination instruments for conventional ones, rather than trying to design the panel for optimum utiliz-



ALPA proposed panel (top) for use on new airline jets and turboprops differs from present CAR/SAE standard panel (bottom) in its location of all basic pitch axis instruments along the top row. The azimuth situation display is centered beneath the horizon/flight director to give a "crosshair" arrangement.

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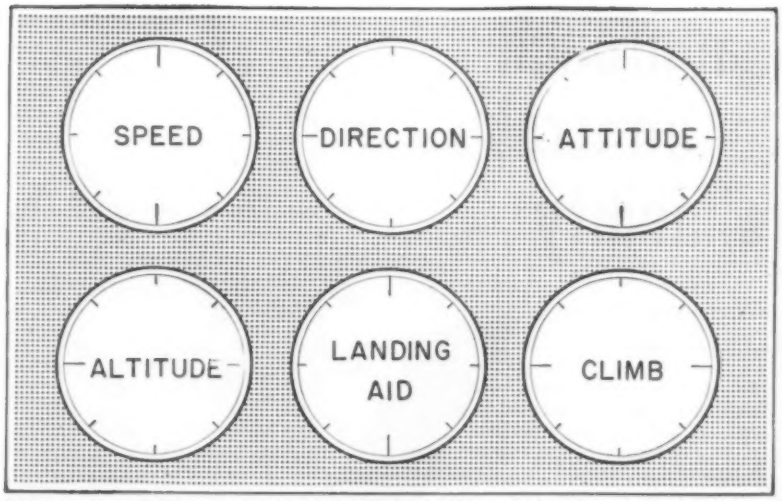

CAA proposes CAR revision which would standardize only location of "basic six" and combine present four SAE/CAR standard panel layouts into one in which instruments are identified by their function instead of by specific name.

ation of their increased capabilities, ALPA pilots say.

Integrated flight instruments have come a long way in their airline acceptance in the past several years. Most, if not all, carriers have specified integrated flight instruments for their new jets and turboprops.

During this period there have also been changes in the instruments themselves.

For instance, when SAE prepared its "System 4" alternative, Sperry had only one integrated instrument—its "Zero Reader." Today, Sperry offers two instruments, one a combination horizon/flight director and the other an azimuth situation display.

This in itself has obsoleted the "System 4" alternative arrangement in SAE's standard.

Proposed CAA Revision

The Civil Aeronautics Administration has proposed a minor revision to the present CAR/SAE standard panel which is on the agenda of the CAR annual review meeting this week. SAE originally spelled out standard locations for the panel clock, turn-and-bank indicator and auxiliary omnirange controls. CAA now believes that it is only necessary to standardize the location of the "basic six," giving more freedom in locating the other instruments, providing they are adjacent to the "basic six."

CAA also proposes to combine the SAE standard and its three alternatives into a single panel in which instruments are identified by function rather than by specific name. For example, one of the existing SAE panels applies when a directional gyro is used and an alternative panel applies when an RMI is used.

CAA proposes instead to identify the location of the "direction" instrument instead of listing the specific instrument type. The specific proprietary names of integrated flight instruments also would be eliminated in favor of functional descriptions.

Under this proposed "semantic" change, the top row of three instruments would be labeled "Speed," "Direction," and "Attitude." The bottom row would be identified as "Altitude," "Landing Aid," and "Climb." (Rate-of-climb.)

Presumably this change is intended to give the CAR/SAE panel more flexibility to accommodate future developments in integrated flight instruments without requiring revisions to meet each new development. However, even with the proposed revision there are interesting problems posed by the use of integrated instruments. For example, should the new Sperry combination horizon/flight director be installed at the location identified "Attitude," or in the one marked "Landing Aid?" It provides both functions.

Pro and Con

An official of one major airline, who has followed the SAE S-7 committee program closely, although not a member, sums up his opposition to the ALPA proposed change this way: "How can we get the industry to accept standardization if we change the standard every couple years?"

An ALPA representative answers the question raised in this way: "If the USAF adopts its proposed new integrated panel display, the CAR/SAE standard is going to have to undergo basic revision to our crosshair arrangement in a matter of five years or less. And it will face still another revision

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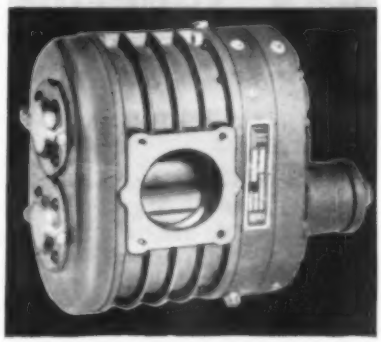

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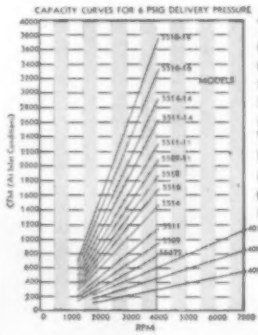

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Compact and lightweight, this highly reliable temperature control uses only standard electro-mechanical components—no electronic equipment. Its design simplicity eliminates costly maintenance training. The instrument's checkout procedure is familiar to any electrician.

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if and when the Navy's new TV tube display comes in."

Several new Navy flight instrument developments now under way could possibly force revisions in the present ASSP standard panel in less than five years, a Navy spokesman told AVIATION WEEK.

A non-partisan observer sums up the situation this way: "Considering the many years during which aircraft instrument designs remained static, it is unfortunate that we just got around to panel standardization at a time when revolutionary changes are taking place in flight instrument design concepts."

List of Astronautics Literature Is Prepared

The first selective listing of background literature on astronautics and the related sciences has been prepared by the Educational Division of General Astronautics Corp., P. O. Box 26, Oyster Bay, N. Y.

The bibliography is available on request; it includes book at all levels from juvenile to Ph. D. and in half-a-dozen languages.

The company would appreciate any suggested additions of books in print in any language and in the astronautical field.

General Astronautics is currently working on a $30,000 study contract for advanced guided missile designs for the Army Ballistic Missile Agency, Redstone Arsenal.

Solar Co. Expansion to Increase Jet Production

Solar Aircraft Co.'s Des Moines, Iowa, plant will be expanded by a 117,000-sq. ft. addition. Construction will get under way at once. It is expected to be completed this year.

Substantial increases in Solar's production of jet engine components were attributed to the need for the additional manufacturing area, which will boost Solar's total plant area in Des Moines and San Diego to approximately 1,227,000 sq. ft.

Navy Contract Awarded For Mobile Powerplants

A $264,000 Navy contract has been awarded to Consolidated Diesel Electric Corp. for trailer-mounted mobile electric powerplants. Labeled NC-7, the units mount gasoline engines which drive two 28 v. d.c. generators and one a.c. generator which are used to start jet aircraft.

Feature of the generator is an electric motor drive which allows the set to be propelled.

NEW 8 CHANNEL

Sanborn oscillographic recording system

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THIS new self-contained 8-channel oscillographic recording system, primarily for (but not limited to) analog computer recording, measures only 46½" x 27" x 22". In a single, space-saving mobile package, the user has a complete system for analog computer readout recording. Input cable connections are easily made at the top of the back panel. Eight groups of controls for the eight channels are conveniently located on the sloping top panel. Driver Amplifier chassis are easily withdrawn from the lower part of the console for inspection. Paper loading is quickly done from the top.

Features of the Model 158-5490 system include 0.1v/cm to 100v/cm sensitivity; over-all linearity of 0.25 mm over the entire 4 cm of the chart; drift less than 0.5 mm/hour; push-pull or single-ended input; miniaturized dual-channel DC amplifiers of improved current feedback design; 5 meg. input impedance each input lead to ground; true rectangular coordinate recording; nine chart speeds from 0.25 to 100 mm/sec. Frequency response is flat to 20 cps, down 3 db at 60 cps for all amplitudes to 4 cm peak to peak.

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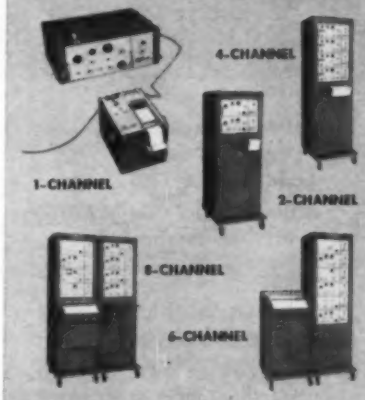

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Russian Engineering Training, Part Four:

Graduate High on Books, Initiative Low

By Leon Trilling*

A unique and significant feature of the Soviet industrial system is that each industrial ministry formulates and carries out a research and development program devoted to its particular field. The ministry not only supervises the research programs of that industry's engineering institutes but also directs a number of institutes devoted exclusively to applied research.

The Aeronautical Production Ministry supervises several research institutes:

- **Central Aero- and Hydrodynamic** Institute (TsAGI), the oldest, largest, and best-known of the aeronautical institutes, founded in the 1920's and concerned mostly with basic problems of aerodynamics and structures. Its fields of interest coincide with those of the faculty of airplane design.
- **Central Institute** for Aircraft Engines (TsIAM)
- **Flight Test** Institute (LII)
- **Institute** for Aircraft Equipment
- **Institute** for Aircraft Materials (VIAM)
- **Central Institute** for Aircraft Fuels and Lubricants (TsTATIM).

There is a large number of others. (The total number is 40).

National importance of the aviation industry, the heavy reliance which it must continuously put on research, and the size and cost of aeronautical equipment have caused the main aeronautical research institutes to become large organizations. The principal branch of TsAGI, located at Zhukovskii, 25 miles southeast of Moscow, is estimated to employ 2,500 people of whom approximately 500 are graduate engineers. It has office and test facilities which cover more than a square mile and has its own electric power station and railroad line.

In this respect, TsAGI is not significantly different from the major installations of the National Advisory Committee for Aeronautics, which employ 3,000 to 6,000 people and constitute full communities with their own supplies of power and other utilities.

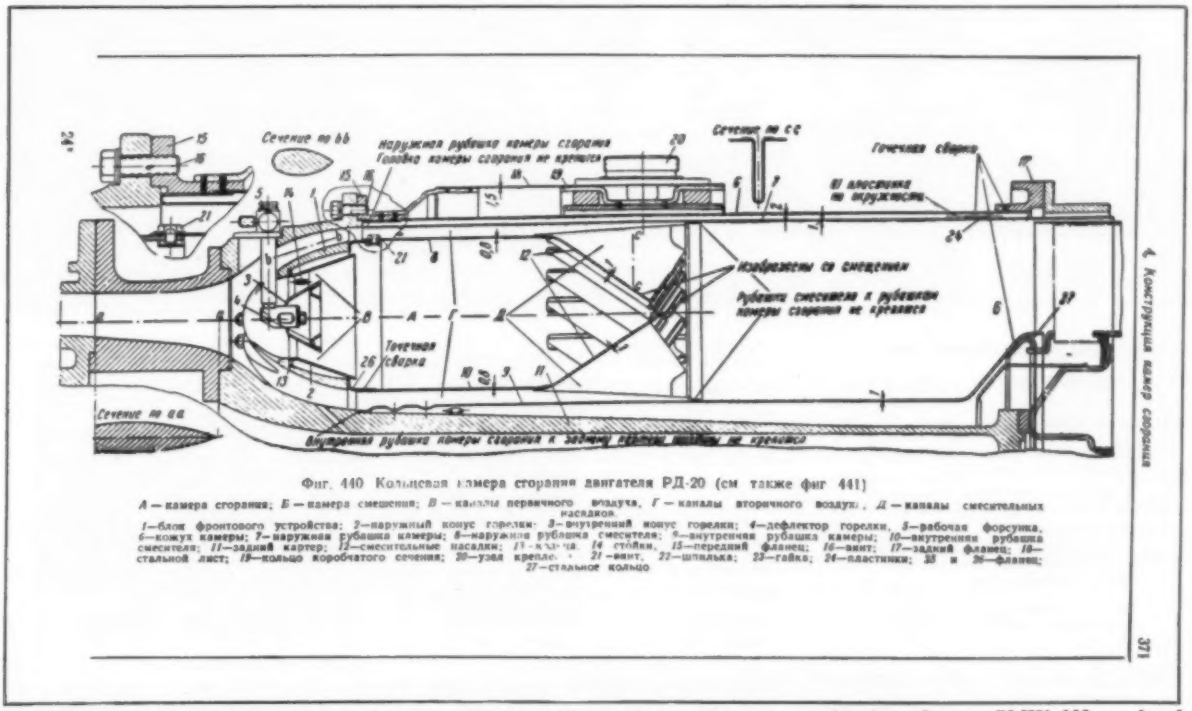
The two functions of the research institutes are the training of graduate students and the formulation, investigation, and solution of technical problems which arise or are likely to arise in the industry. Since the research plays a fundamental part in graduate training, these two functions overlap somewhat.

Graduate students (*aspiranty*) of the research institutes are recruited from several sources. Some are selected from among the top 5% of the university and engineering institute graduates, apparently by agreement between the supervising academic chair and the state examining commission at the time diploma projects are defended. Some few places are left open for nominees suggested by the ministry, often on the basis of party record. Some vacancies are filled on the basis of open competitive entrance examinations. It is not clearly known how many aspirants are admitted by each of these methods, but it is certain that the total number of graduate students at each institution is closely supervised by the central authorities.

It follows from the principle that the prime requirement for graduate study is a qualified thesis supervisor and adequate experimental facilities that numerous Academy and ministry research institutes are authorized to award graduate degrees.

Among aeronautical institutes,

Dr. Trilling is assistant professor of aeronautical engineering at the Massachusetts Institute of Technology, and author of this study, "Soviet Education in Aeronautics: A Case Study." This is the last of four parts.



Фиг. 440 Кольцевая камера сгорания двигателя РД-20 (см также фиг 441)

А — камера сгорания; *Б* — камера смешения; *В* — каналы первичного воздуха, *Г* — каналы вторичного воздуха, *Д* — каналы смесительных насадков.

1—блок фронтового устройства; *2*—наружный конус горелки; *3*—внутренний конус горелки; *4*—дефлектор горелки, *5*—рабочая форсунка, *6*—кожух камеры; *7*—наружная рубашка камеры; *8*—наружная рубашка смесителя; *9*—внутренняя рубашка камеры; *10*—внутренняя рубашка смесителя; *11*—задний картер; *12*—смесительные насадки; *13*—кожух; *14* стойки, *15*—передний фланец; *16*—винт; *17*—задний фланец; *18*—стальной лист; *19*—кольцо коробчатого сечения; *20*—узел крепле- ; *21*—винт, *22*—шпилька; *23*—гайка; *24*—пластинки; *25* и *26*—фланец; *27*—стальное кольцо

COMBUSTION CHAMBER cross-section of Russian RD-20 axial-flow turbojet. This engine is based on German BMW 003, produced in quantity during World War II. Russian version of this engine has been redesigned for much greater thrust.

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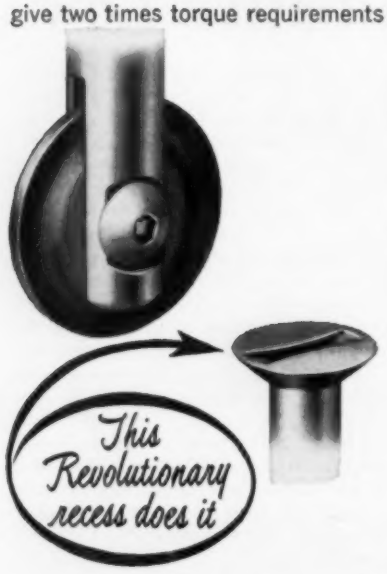
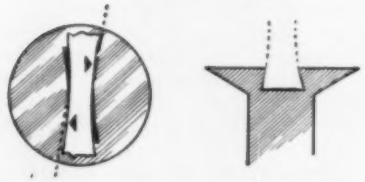


Here's why...

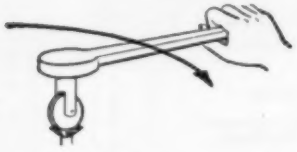


FULL BEARING THRUST

The entire face of the driver blade thrusts against the entire face of the recess, not just a point to point contact.

LOCKED-IN BLADE

The recess is undercut on both sides so a few degrees of torque locks in the driver blade and eliminates outward component of force.



RIGHT ANGLE WRENCHING

Driver can be used 90° to the plane of rotation to exert unlimited torque in insertion or retraction of fastener.

- Shallow recess does not affect head strength in critical materials.
- The combination of high torque values and a shallow recess permits use of small heads.
- Blanks for the Hi-Torque recess are forged in the solid head condition to maintain ideal flow lines.

Write for brochure giving complete specifications and dimensions.

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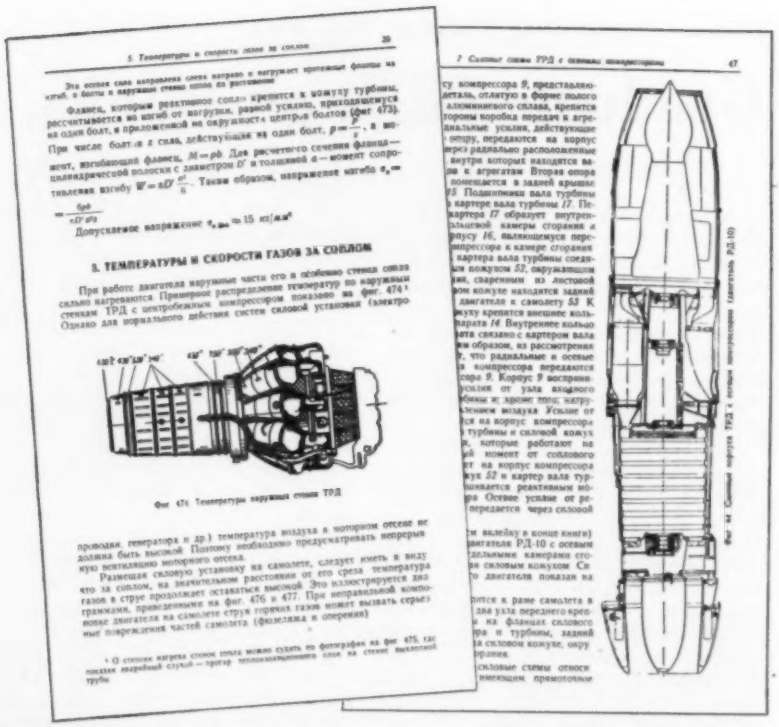

RUSSIAN TEXTBOOK pages show drawings of contemporary engines with complete physical and technical details. Temperatures of the outer walls of a centrifugal-flow engine, designated only as TRD in the picture, are shown (left); at right is a section through the RD-10, an axial-flow turbojet equivalent in size and internal geometry to the German Junkers Jumo 004 of World War II. Russian redesign of the engine has boosted its thrust from the original value approximating 2,000 lb. to almost 7,000 lb.

TsAGI (Aerodynamics and Design) and TsIAM (aircraft power plants) are authorized to conduct training which leads to the doctor's degree. In fact, these institutes turn out *kandidats nauk* and doctors at an only slightly lower rate than academic institutions.

Aspirants (graduate students) at research institutes find test facilities and thesis topics readily available. For their course work, large institutes such as TsAGI (where there are 30 or 40 aspirants on the staff) offer the services of their senior staff members, who are generally professors on part-time duty (many senior professors of the Ordzhonikidze Aeronautical Institute in Moscow are senior staff members of TsAGI). Since these men hold evening or Sunday classes, the aspirants' study conditions are not radically different from those at a university.

Graduate training at the research institutes is probably not exempt from the difficulties confronted by the Soviet educational system in its efforts to expand and to improve graduate training generally. Soviet opinion ascribes the failure to develop a larger number of original research scientists to two principal reasons: inability on the part of the aspirant to do original work, and inability of the supervisor to gauge the problem assigned or to give suitable advice and support.

Comments of Soviet professors on the first point indicate that student immaturity and inexperience are primarily responsible for their inability to do original work. Such comments imply that a student just out of school, where he has been led by the hand, will not recognize a research problem if he sees one and would not know how to tackle it if he did.

On the other hand, the increasingly severe demands of modern technology are sometimes beyond the abilities of many practicing engineers, especially those trained before 1939, many of whom have grown into responsible positions. There is, therefore, a great demand for scientists with advanced training.

In the 1930s the engineer, the practical builder of a new world, overshadowed that old fogey, the professor (usually trained under the Tsarist regime). The difficulties experienced by insufficiently trained Soviet engineers soon changed the picture. An attempt was made from 1930 to 1936 to increase the number of professors and to bring the academic world more completely under the influence of the party by appointing many younger Soviet-trained engineers

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By last week, General Electric jet engines had logged 4,000,000 hours more flight time than any other U.S. jet engine manufacturer. And every hour since, G-E J47's and J73's, plus the first of the new J79's, have added the equivalent of another year and a half of flying time to the total.

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Flight data helps speed jet progress. This engine flight experience has helped General Electric design engineers trim months from the development cycle of new engines. The J79, for example, was brought from drawing board to test cell an entire year ahead of the timetable formerly thought feasible.

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ENGINEERS: Illustrated booklet "Thrust & Progress" is available for qualified engineers interested in the field of flight propulsion. Write: Technical Personnel, Building 100, AGT Division, General Electric Company, Cincinnati 15, Ohio.

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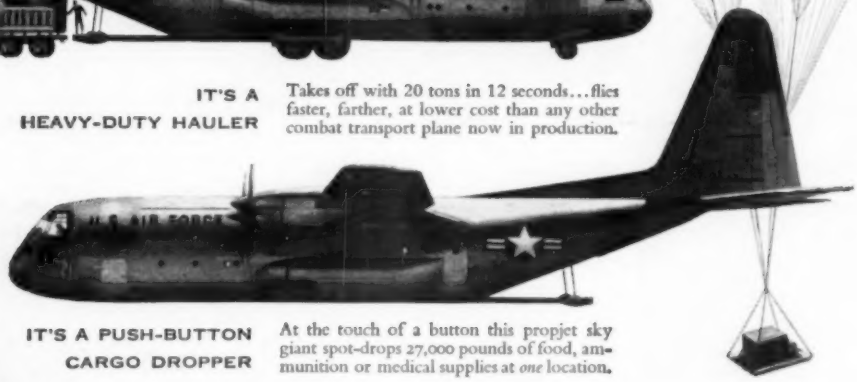

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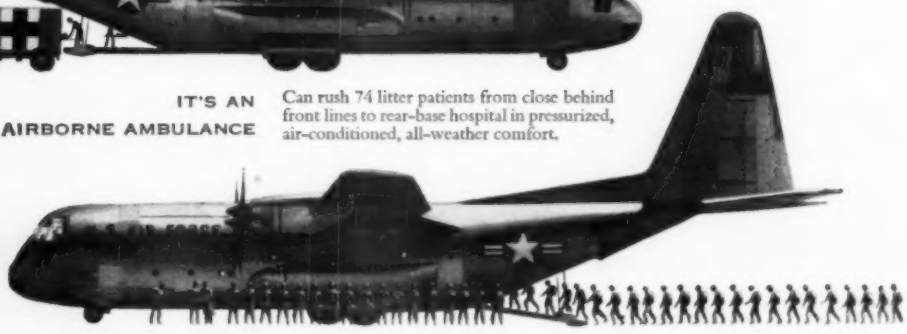

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Лица, окончившие средние школы с серебряными медалями, и отличники техникумов, включенные в 5% выпуска, подвергаются вступительному экзамену по математике (устно и письменно) в период с 15 по 25 июня.

Принятые на первый курс обеспечиваются стипендией согласно действующим положениям.

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Адрес: город Казань, улица К. Маркса, 10.

ADVERTISEMENTS from Communist youth newspaper, Komsomolskaya Pravda, inserted by leading Soviet aviation institutes competing for qualified students. Not so long ago the Russian press was still so security conscious it rarely mentioned the existence of these schools. Clipping (left) is an ad by the Moscow Aviation Institute (Ordzhonikidze) offering 5 and 5½ year courses "to prepare highly-qualified specialists for all branches of aviation technology," with jobs open to graduates in design bureaus, scientific research institutes and factories. Ad (right) was placed by the Kazan Aviation Institute, which offers training for engineer-mechanics for aircraft and aircraft engine manufacturing jobs, engineer-electromechanics for aircraft instrument manufacturing positions and engineer-radiomen.

to professorships, thereby somewhat lessening the prestige of the older generation of pre-Revolutionary professors. But the new generation proved unequal to its task, and the teaching profession was reorganized in 1936.

Although the student body continued to grow, the number of professors was halved. Very stringent requirements were put on a professorial appointment, and the leadership in education and research swung back to the older generation.

Three out of the four leading research scientists in fluid mechanics (Sedov, Golubev, Loitsianski) were of that generation. The average age of a Soviet professor is now 59, and there is no policy of retirement at any age.

Science Emphasis

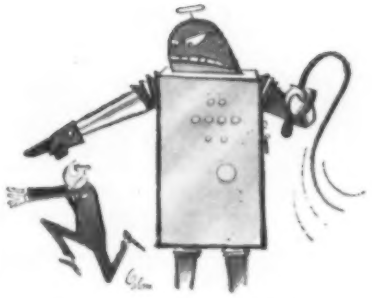
But the old generation must pass away and a new body of creative scientists must be developed. Hence the present emphasis on graduate correspondence courses, the financial rewards offered for an advanced degree, and the fact that the scientist is now praised as the prime builder of the Soviet state—a trend that is likely to become stronger.

In an effort to increase the number of aspirants who become *kandidats*, some officials have suggested that older graduates with some years of practical experience, who presumably are stable and self-reliant, be given preference in the selection of aspirants. This procedure might require higher allowances (*stipendii*) for graduate students since graduate stipends now are approximately equal to starting salaries for engineers (800 rubles), and an engineer with several years of experience would take a pay cut if he went back to school. But it is felt that it would be money well spent.

It also has been recommended that five years of engineering, research or teaching experience be required for admission to graduate standing. Some expression has been given to the feeling that the change in intellectual climate between undergraduate school and graduate school is so severe that it might be profitable to extend the length of *aspirantura* by one year.

Soviet comment lays the other weakness of the present system of training advanced students at the door of the professors themselves. It has been pointed out that because of their excessively heavy work load and the pressure for successful results in their research, the professors are too busy to pay enough attention to their students, who flounder and get discouraged; that some professors assign problems which are too easy to be a real challenge; that others do much of the work themselves to protect their own positions.

Since the only remedy for these faults is to lighten the professors' load, it has been suggested that professors be forbidden to hold several jobs. Since it is the most prominent professors who are most guilty of job accumulation, it is obvious that extended contact with them would be valuable to prospective scientists, and this appears to be a con-



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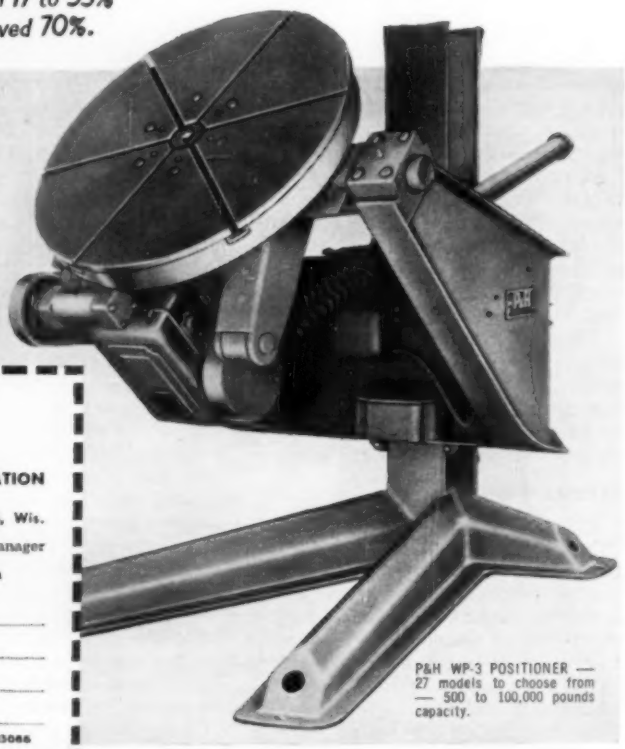

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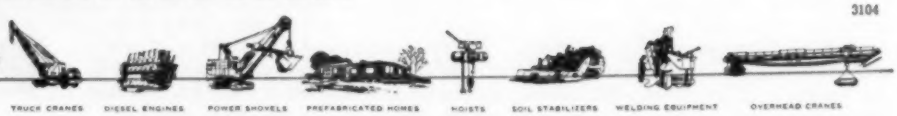

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structive proposal. But these same professors perform such essential functions in coordinating and planning research and development for the production ministries that their services in that capacity could hardly be dispensed with. In a contest between universities and the production ministries, the outcome is a foregone conclusion.

A second suggestion is that the requirements for appointment to a professorship be relaxed, especially for elementary subjects. It is now the rule that a professor must hold a doctor's degree and a docent a candidate's degree. It is argued that, since there is a shortage of such people, it would be advantageous to save these valuable men and women the chore of teaching elementary courses and to reserve their precious energies for advanced training. But, since this has already been done at the smaller universities and institutes, benefits from an extension of the practice might not be very large.

Limit Originality

It would thus appear that insufficient contact with mature creative teaching personnel and strong emphasis on factual knowledge useful for immediate use in productive pursuits (design and manufacture) have severely limited the number of young people who give promise of originality and show an interest in research by taking an advanced degree.

Since such young people must constitute the teaching corps of the coming generations, and since the further expansion of the engineering profession can proceed only if the number of skilled professors also increases, this situation is causing serious concern to Soviet educational leaders.

Meanwhile, the job of doing research to support the material development of industry proceeds, even if it does not serve as the basis for sufficient advanced training. An important proportion of the necessary research programs is formulated by the senior institute staff members on a long-range basis to supply background information. The detailed studies of transition of laminar boundary layer flow to turbulence and its effect on the drag of wings which took place in 1935-1939 at TsAGI, for instance, paralleled a similar investigation carried out at the Langley Field Laboratory of the National Advisory Committee for Aeronautics in the United States and led to the development of low drag airfoils which increased aircraft speeds by 15% with no increase in power required.

To develop effective programs of this sort, improve the quality of the product, and simplify its manufacture are among the responsibilities of the professors who plan and supervise the activities of these institutes and of the re-

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Thread Size	Esna No.	#s per C	Esna No.	#s per C	Esna No.	#s per C
4-40 NC-3B	M-40	.14	MJ-40	.05	LHTM-40	.08
6-32 NC-3B	M-62	.26	MJ-62	.09	LHTM-62	.13
8-32 NC-3B	M-82	.42	MJ-82	.16	LHTM-82	.19
10-32 NF-3	M-02	.50	MJ-02	.19	LHTM-02	.25
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5/16-24 NF-3	E-054	1.20			LHTE-054	.64

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B. Next in cost *and lightest of any* self-locking hex nut is the blue dyed "J" line of high strength aluminum nuts. They are qualified to meet the same AN requirements as the two steel nuts shown. (Temp. to 250°.)

C. Third is the new ESNA LHTE-TM line of light-weight all steel nuts, suitable for use at temperatures up to 550° F. These nuts have been considerably lightened . . . consistent with safety and performance considerations. *Conforms to AN364 thin nut heights; will meet tensile requirements for full height AN365 parts.*

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☐ Here is a drawing of our product. What self-locking fastener would you suggest?

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PIONEERS IN THE DEVELOPMENT OF AIRCRAFT PNEUMATIC SYSTEMS

search section of the ministry, which is staffed partly by academic colleagues, and which evaluates and finances their work. For senior scientists in a ministry there appears to be a policy of rotation between advisory committees, research institutes, engineering schools, and major plants. Thus the ministry remains informed of what research goes on, the institutes have access to the powers that be, and the senior professors keep their fingers in every pie. For instance, Professor Shishkin, from 1946 to 1953, seems to have rotated between the Electrical Engineering Chair of the Ordzhonikidze Moscow Aeronautical Institute, the directorship of research of TsAGI, and a position in the Ministry of Aircraft Production.

In addition to carrying on their important programs of independent research work, the institutes cooperate with the productive groups whenever a special problem arises.

Factories usually have their own laboratory section where some test programs may be performed. When the factory laboratory proves inadequate the factory director may request through channels that the research section of the ministry assign the program or problem to a suitable institute.

Many Jobs

A quicker, more effective procedure, possible when personal contact exists, is for the factory director and the institute director to propose a joint research program to the ministry. Then a mixed staff uses funds and facilities from both. Either a factory and an engineering institute or a factory and a research institute may organize such joint projects, which are particularly suitable for practical theses. A variation of this procedure consists in the factory requesting the institute to handle the project, financing it if the factory lacks skilled personnel for the task.

(In this connection complaints have been voiced about insufficient work of this sort being assigned to engineering institutes, but this is rather a reflection on the school facilities than a failure to use its staff. Key personnel of the staff will get a job while they wear their other hats and work at the research institute.)

Finally, in one way or another, many professors do individual consulting for industrial concerns. A professor may not hold more than two full jobs, but he may draw as many quarter-salary checks as he wishes. For instance, in 1947 the well-known designer, Yakovlev, held down six jobs.

Professorial consulting done in moderation has proved to be a valuable connection between industry and science, but it has been overdone. Professors have been known to sell their names as consultants to factories for a rather high fee and then get the work done by their

(Advertisement)

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.

BY MARVIN MILES

If you search for the antithesis of the airplane, you can't find a better example than an Army tank; yet, in some ways, they're much alike. So just for a change in pace, how about trying your hand as a tanker?

At Camp Irwin, California, you climb up the rough, steel flank of the 50-ton Patton and let yourself down through the hatch into the turret, much the same as if you're settling into the cockpit of a jet fighter.

You find the inside is filled with gear — about as roomy as a hollowed-out bowling ball — but no worse than the cockpit of a B-47 Stratojet when you're riding fourth position. It's not as comfortable as a plane though. Meager cushioning on small seats — no belts or straps for safety — jutting steel and sharp corners everywhere.

The big, black breech of the 90 mm. gun dominates the turret with a metal rail enclosing its recoil reach, and a .30 caliber machine gun is installed alongside it.

Here's one of the big differences other than beauty, speed, range and maneuverability. Both plane and tank are essentially firing platforms, of course, but triggering armament in a tank is almost like putting a rifle to your shoulder. No really remote control or automatic triggering such as that used in aircraft. It isn't necessary.

In a plane your armament is all loaded. When it's fired, there's no reloading. Not so in a tank. The white-painted interior is filled with ammo, racks and slots for both high explosive and armor piercing shells some 38 inches long — big white boxes filled with belts of .30 and .50 caliber cartridges.

Firing in a plane is crisp and clean, ordinarily. The blast is muffled, the smoke whisked away by the slipstream. In a tank it's all noise and smoke and dust. You curl your fingers and shove the heavy shell home with an upward thrust of the palm so the snap-closing breech block won't mangle your hand.

The deafening blast of the shot knocks you backward as the 50-ton monster lurches on its treads. Dust whirls outside in a small cloud as the breech block drops open to discharge the empty shell case clanging to the steel deck, and a stinking, eye-stinging white smoke fills the tank until a blower clears the air.

But don't discount the accuracy of the big 90. The Patton is equipped with a Northrop range finder, and it's a dilly once you're trained to use it. At 2400 yards the gun seems to be firing at point blank range. The shells burst from the muzzle at 3300 feet per second, scream across the desert and explode dead-center on the target tank. The finder, incidentally, is accurate to 4800 yards, the gun itself will carry 19,000 yards.

Coordination of the four crew members — commander, loader, gunner and driver — is required in a tank as it is in the air — not to the fine, exacting degree demanded by a combat plane, but coordination nevertheless. Oddly enough, speed, too, is a factor, speed in human efficiency. A tank crew must be able to stop, sight, fire and hit within 15 seconds or risk being slugged itself by enemy armor.

Driving a tank, naturally, is vastly different than flying a plane, although the Patton is surprisingly sensitive and definite in its reactions to the wheel which is not unlike the control wheel on many aircraft. The plane turns smoothly. The tank turns in quick, grabbing jerks and gives you the idea it can do a 180 on a dime.

Barging across the desert is something like steering a battleship across a placid ocean, mashing ponderously across gullies and ridges, cactus and yucca. The hills, however, are the thrill. Wide open, on good terrain, the big chunk of steel will do about 28 m.p.h. On steep, rugged climbs you find she slows almost to nothing; yet she thunders on inexorably even though she feels as if she'll tip over.

Lastly you try the flame thrower, mounted on a World War II Sherman as a special attack tank that would be called up for stubborn resistance. You press the foot buttons. There's a second's hiss, then the dull roar of the arcing blaze spitting out to envelop its target with clinging, searing death — and you think what air-dropped napalm could do to you in a Patton.

You talk with the tankers, ask about anti-tank weapons such as napalm, shaped charges and high velocity aircraft rockets. They shrug and quip:

"It's a job. What if we caught your airplanes on the ground?"

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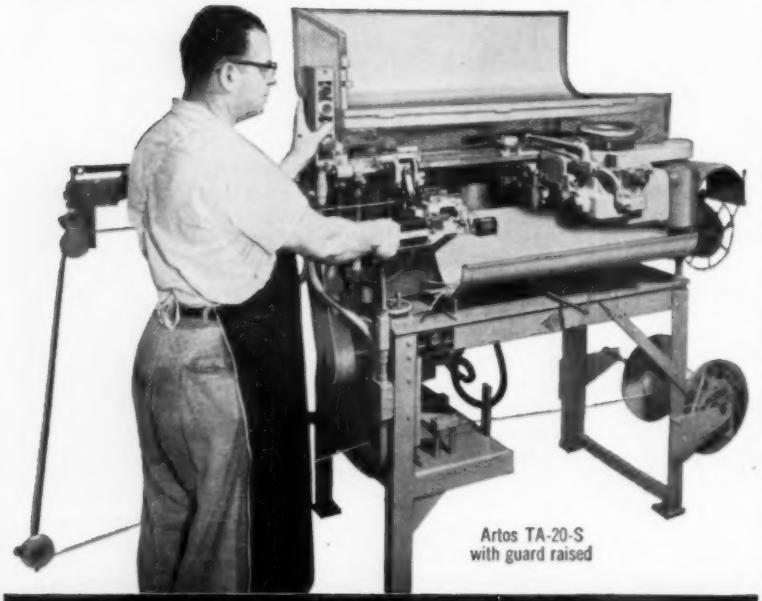

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students, who would receive a much lower fee. Though this practice is not encouraged, the culprit is rarely caught unless he takes a political misstep. Then the exploitation of his students is just an additional proof that he is a bourgeois deviationist.

Science Organization

To recapitulate the organization of scientific and engineering work in the aircraft industry:

- **Plans and requirements** section of the Red Air Force, staffed primarily by graduates of the Zhukovskii Military Air Academy, draws up a set of specifications for assignment to a design bureau. Senior men of the requirements section are connected to the teaching and research staff of the Zhukovskii Academy and so are able to keep themselves technically up-to-date and are able to draw on informal advice from colleagues who are members of the Academy of Sciences or of the faculty of Moscow University. (The late Professor V. V. Golubev in aerodynamics and Professors Col. Umanski and Gutsev in structures and metallurgy are examples of such links. They also advise the Academy of Sciences research institutes and the scientists at universities on what research problems are of urgent importance.)
- **Design groups,** which are teams of 300 engineers mostly trained at aeronautical institutes, with some Zhukovskii Academy graduates at the upper levels, prepare designs, drawings on the latest results of the research institutes of which some of their senior engineers are part-time staff members. Cooperation is enhanced by the rotation of senior personnel between ministerial technical committees, design groups, research institutes, production assignments, and engineering institute chairs. A great effort is made to keep the top-level men up-to-date and technically active.
- **Industrial production** teams cooperate with the institutes. They exchange views with the design teams regularly at conferences called to discuss the details of designs assigned to them and they make sure that designs are suitable for mass production.

It appears, therefore, that within the family of organizations set up to train aeronautical engineers and to plan, design, and build aircraft there are numerous avenues for the exchange of ideas and the transmission of information, avenues resulting from the multiple activities and responsibilities of a relatively small number of senior engineers and scientists who, in various combinations and permutations, constitute the committees which run all the technical activities of the ministry.

This "multiple hat system" works effectively because the ruling group is

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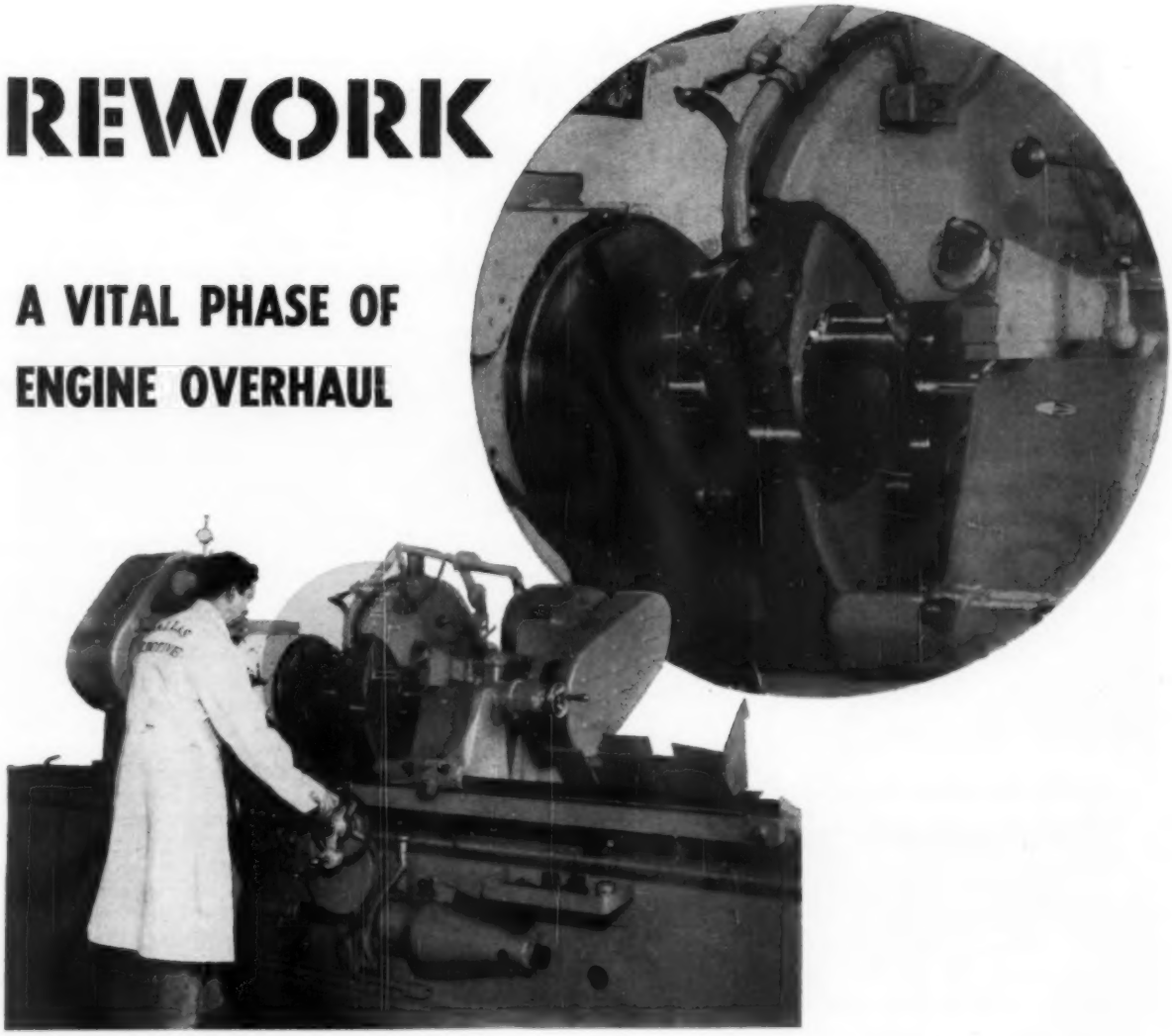

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small enough for easy personal contact. But it also puts an extremely heavy burden of work and responsibility on its members, and reflects itself in particular in the mechanization of teaching at the acronautical institutes.

Although the system appears rather effective in keeping scientific information circulating within the ministry, several observers indicate that there is very little flow of information from one ministry to another. Some connecting links exist in the basic work of university research and in the activities of the technical section of the Academy of Sciences. But the Soviet Union is too large a country to allow much free movement of scientists from place to place, and the scientists are frequently so busy with their own work and the work of their own ministry that they do not find time to take an active interest in other ministries' problems.

In most Western countries there are two additional means of communicating scientific results: meetings of scientific societies, and publication in technical periodicals.

Neither of these methods has received much development in the Soviet Union. Professor Bernal reports that only 10% of the total scientific population in the Soviet Union belongs to technical societies, and that such societies are not active on the local level where the base of the scientific community can get together and exchange ideas.

Soviet scientists or engineers gather mainly at very large organized national meetings where only the leaders attend. For a country as large as the Soviet Union and as active as it is in the technical fields, the number of high-grade scientific publications is extremely low. In addition to the *Doklady Akademii Nauk* (Proceedings of the Academy of Sciences), which publishes abstracts of no more than four pages, we can discover only 25 Soviet publications for the entire range of the natural and applied sciences.

The Soviets publish important results in basic research (mathematics, physics, chemistry, geology, biology, and their subsidiary fields) but very few engineering journals comparable, for instance, to the Aeronautical Review or the Proceedings of the American Society of Mechanical Engineers. Only two Soviet journals publish articles on applied science—*Prikladnaya Matematika i Mekhankia* and *Izvestia Akademii Nauk, Otdel Tekhnicheskikh Nauk* (Applied Mathematics and Mechanics and the News of the Academy of Sciences, Division of Technical Sciences). Various universities and institutes publish reports and proceedings in an unsystematic way—but not on matters pertaining to specific products or engineering know-how.

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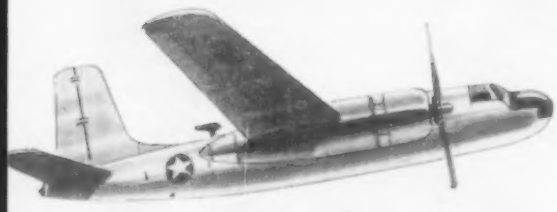

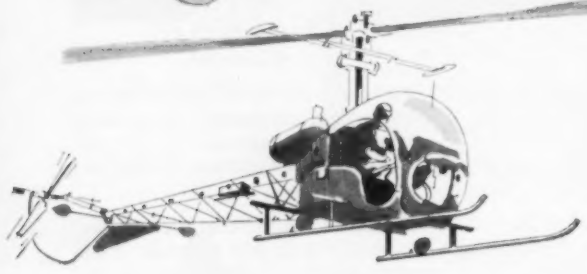

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it an offense to divulge without authorization the plans or details of any device which plays a significant part in the country's economic and military planning. All material suitable for publication in an engineering journal is therefore classified.

There seems to be, however, some relaxation of these rules, and recently several engineering research journals have appeared: Telomechanics of Automation (1940); Radio Technique (1945); Electricity (1951); Acoustical Journal (1955); Heat Engineering (1954), among others. While they do not describe actual products, they show some experimental equipment and discuss fundamental engineering know-how.

The very limited Soviet scientific publication effort explains many instances of duplication of effort, especially in the fields of auxiliary equipment, and some serious delays. For instance, the aeronautical engineering profession developed an engine regulator which the compressor builders had successfully used for three years.

This serious failure of communication is only partly due to overorganization within a ministry, lack of overall scientific and engineering planning, and overwork of key personnel. In the main it seems to be a product of the secretiveness of the Soviet atmosphere, where the leadership of one ministry does not trust that of another, where all fear to let information leak abroad, and where many people may hesitate to publish results and ideas which may later become controversial and haunt the writer.

CONCLUSION

Fundamental purpose of Soviet education in aeronautics—as in all other fields—is to produce technically skilled personnel for the service of the state.

Thus, Soviet education in aerodynamics is, in a sense, a branch of aircraft production. It turns out technicians.

Like any other Soviet production process, it is designed to turn out a maximum number of units of acceptable standard, and both the standard and the production technique vary slightly between research and engineering personnel.

It is generally true that a small number of active qualified scientists is sufficient to carry basic research forward, and that no country can consistently count on more than a few young scientists with the creative energy required to do important new work. The research scientists, whose basic research is indispensable for the development of aeronautics—particularly the theoreticians drawing on an old tradition of original creative work—receive a broad fundamental scientific education and

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contribute their full share of new knowledge and ideas to mathematics and fluid mechanics.

It is apparent that, in spite of some weaknesses, the Soviet educational system has encouraged an increasing number of young men and trained them broadly and intelligently. Led by a small group of gifted men educated under the old regime (Sedov, Loitsianski, Frankl, Golubev) or of their younger, Soviet-trained colleagues (Christianovich, Krassilshchikova, Falkovich), these scientists, acting as small flexible task forces, have solved a number of theoretical problems wisely selected to keep Soviet aeronautical science abreast of any competitor.

The situation appears to be less favorable with the engineers.

Whereas in the sciences there existed a solid pre-Revolution base which required only broadening, in engineering the Soviet system started almost from scratch. Moreover, the regime undertook the task of training a large engineering force while at the same time enormously expanding the national industrial machine. Appreciable progress has been made in both directions, but much remains to be done to create a technical base comparable in engineering instinct to the American or German base.

The main difficulty consists in a chronic shortage of qualified educators. Those available are perpetually overworked and thus unable to perform at top efficiency, and the number of young men qualified to enter an engineering teaching career remains disappointingly below requirements.

Overspecialization

Problem of training a maximum number of engineers for specific tasks gave rise at first to a policy of overspecialization. Although this fault has been corrected to some degree, and specialization now tends to be by ministry rather than by narrow specialty within a ministry, it is still a source of inefficiency and duplication of effort.

We already have pointed out that a ministry of major importance, the Aircraft Construction Ministry, can effectively integrate the various functions of the institutions and men under its control; but this integration and the interchange of technical know-how result from the fact that the ministry's technical activities are completely controlled by a small group of men. Thus coordination and planning are effected on a personal basis rather than as a consequence of the total prevailing professional attitude of the engineering community as a whole.

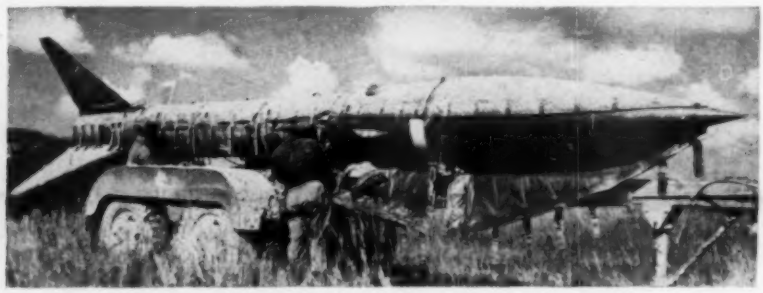
If the aeronautical industry is typical, we would judge that the Soviet engineering community does not yet have either the broad outlook or the physical means (such as professional journals and meetings) for really deep integration of its varied capabilities.

Declining Fervor

There is reason to believe that the pressure of the Soviet regime to enforce a rigid standard of political conformity and the appearance of a new self-perpetuating ruling class have dissipated much of the fervor aroused in the first generation after the Revolution. There is evidence that the young are eager but soon learn a fatalistic, somewhat cynical acceptance of orders from above, and that they seek to improve their personal lot by "playing the angles" of the system rather than by exercising their initiative to suggest or put into effect improvements of the products or operations for which they are responsible.

In this connection, we summarize the impressions brought back by a number of German engineers recently returned from the Soviet Union, where they had worked for several years in fairly close contact with a number of Soviet aeronautical and electrical engineers, and who were interviewed by the author. The following is a summary of their observations:

So far as the technical part of his training is concerned, the Soviet en-



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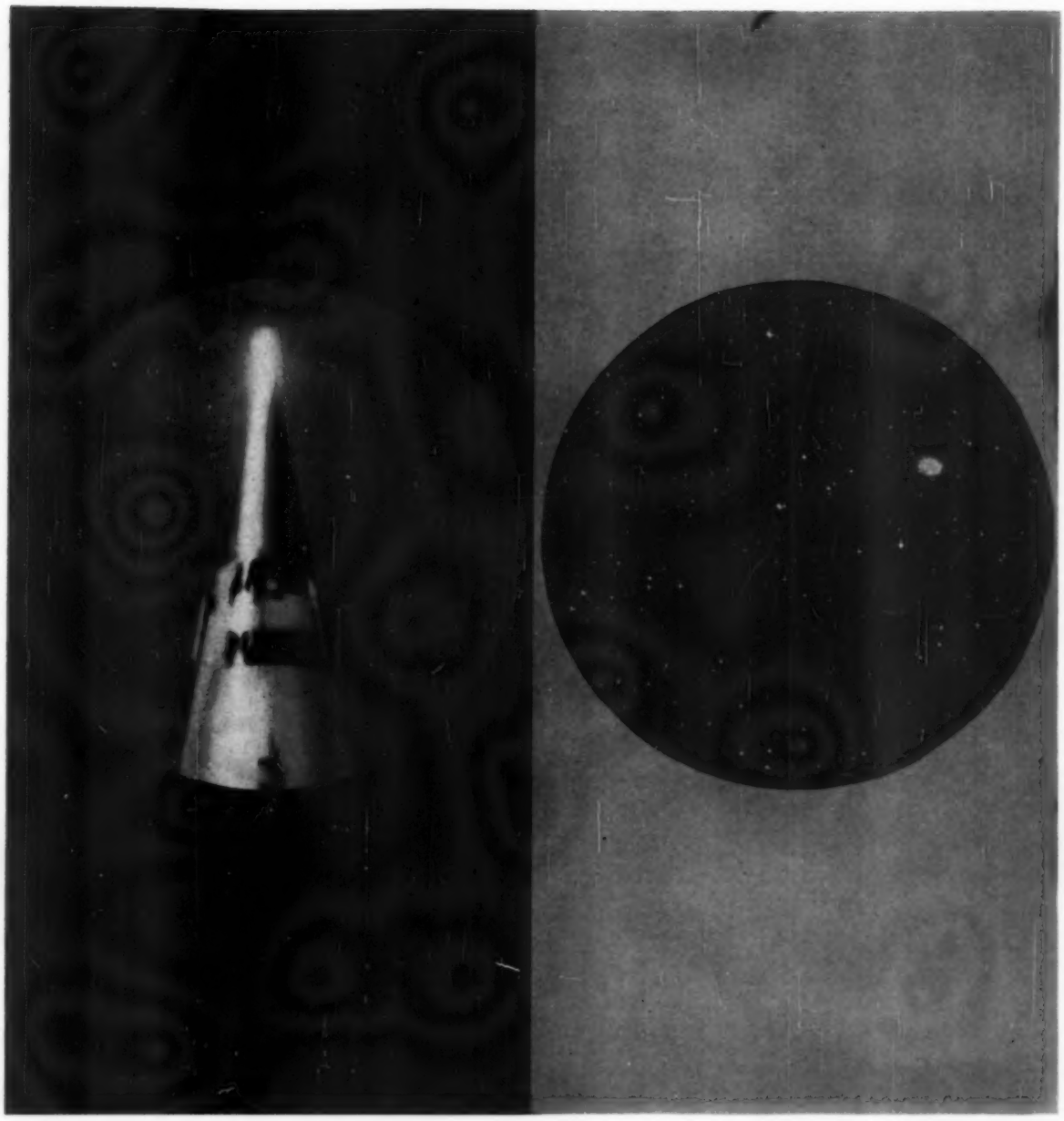

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gineer covers as much ground as the average Western engineer even though his outlook is narrower and his range of technical interests and skills somewhat smaller.

He often displays a preference for theoretical solutions even when they are clearly less effective than a simple test, either because it is easier to apply a set of formulas from the book, or as a strange, persistent remnant of the unproletarian prejudice that brainwork or paperwork is more refined than laboratory work.

Lack of Responsibility

But the real weakness of many Soviet engineers is that they have never been seriously trained to make decisions or to take responsibilities. In their schooling they learned what the book said, and even performed experiments according to strict instructions; but they seldom had enough personal contact with their professors to argue with them, and certainly the psychological climate did little to encourage initiative.

They are ill-prepared to experiment with possible new solutions to a given problem. Especially if trying something new involves the expenditure of state funds.

Afraid of Failure

Soviet engineers are afraid of being blamed in case of failure. They also seem to have difficulty in starting a problem—although once under way they use their extensive knowledge effectively and bring their tasks to a generally successful conclusion.

It follows, of course, that they are excellent adapters and improvers of foreign ideas and equipment even when they fail to give credit where credit is due.

The lack of initiative, the lack of faith in experiment, and a certain reverence for academic title are illustrated by the following incident reported by a returning German who was at the time engaged in helping design an electronic control circuit at a Soviet research institute.

Talented Group

The Soviet leader of the group responsible for that design came to him to ask what power input would be required to obtain a certain signal from a new tube. The German said:

"I do not know."

"But you are a German professor, can't you calculate it?

"No. Let us try several values of input power and find out."

To which the Soviet engineer said:

"Oh! you German scientists! You know the answer, but you won't tell us."

It is our conclusion that there exists in the Soviet Union a group of talented

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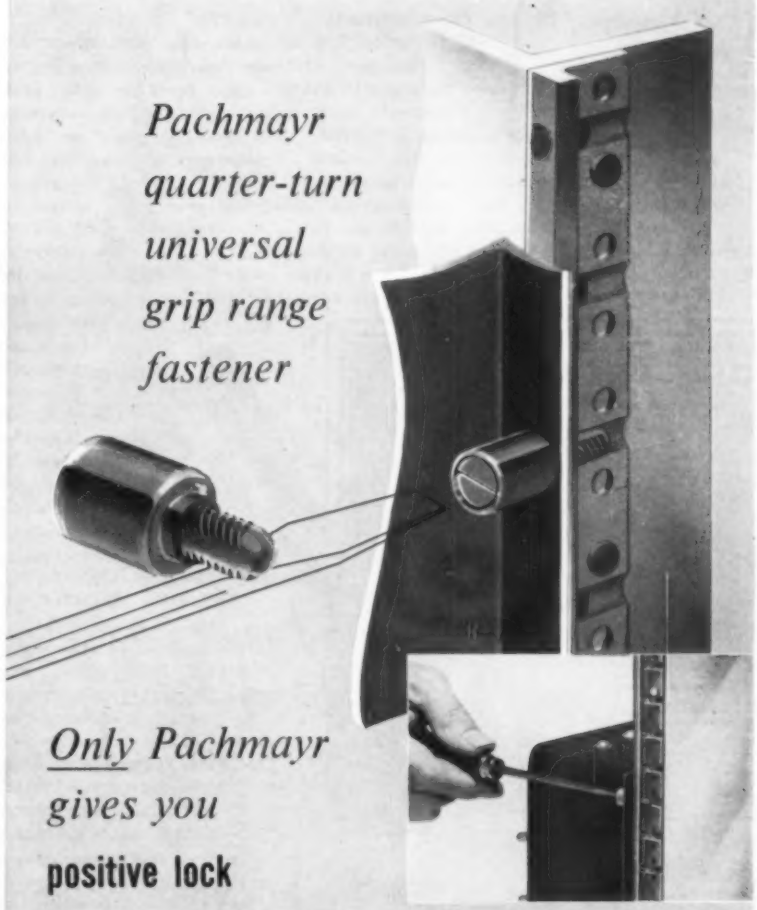

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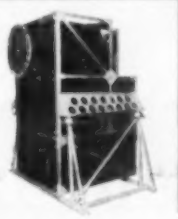

Pachmayr CORPORATION

fastener division

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A letter from Daddy

TO: NARSHA PALMER

Dearest Narsha:

So you're back in the classroom, teaching nuclear physics at Bratberg Abnormal! I know you're happy, with all the tykes trooping up the hill to school, bringing you apples, candy, and home-made rutabaga preserves. Gosh knows, they must be happy, with an instructress who's 27, 100 lbs., 5', brown-eyed, brown-haired, and pretty as a new red top. Modern education is great, and one of the greatest things of all is how you discipline 'em without ever layin' a hand to their little backsides. Believe me, it was different when I was a kid. I got scars the size of flapjacks to prove it, too. So you won't think I'm still a dunce, I want to tell you a pilot NEVER gets through educating himself on the latest developments for safe, all-weather flying. This week, I've boned-up on literature Southwest Airmotive sent me about B. F. Goodrich products. Like the the age-old laws of physics, the principles of B. F. Goodrich design and fabrication always remain fundamentally true and reliable. Falltime for a pilot is De-Icer time and De-Icer is synonymous with B. F. Goodrich. I'm having SAC install the latest B. F. Goodrich De-Icers on my airplane, along with a new set of B. F. Goodrich's famous tires and tubes. Those items, plus my plane's B. F. Goodrich Rivnuts, brakes, wheels, and fire-resistant gas and oil coolant hose make me about as educated a flyin' man as there is in the sky. Back to De-Icers—there's only one model B. F. Goodrich can't top: My half-pint De-Icin' school marm. You're the cream of the crop!

Love, Daddy

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people with drive and ambition who generally are permitted to reach the top, sometimes quite rapidly; that their number has increased as a direct result of Soviet educational policy; but that there are a few men who carry the Soviet engineering apparatus on their shoulders, being simultaneously teachers, scientists, and designers. There can be little doubt that the ability and knowledge of this nucleus is on a par with that of the best men in similar positions anywhere, but at the present time these men do not have adequate support.

By The Book

It is our conclusion that the crosssection of engineers in the Soviet Union has not yet acquired that degree of engineering "feeling" which only broad familiarity with machinery can bring; that they work by the book and require detailed direction.

For this reason, excellent designs must be adapted to inferior execution, and tooling or high-grade workmanship is reserved only to keep parts of the assembly.

During World War II, the United States supplied the Soviet Air Force with a number of P-39 Airacobra fighter planes, not representative of the most effective American designs but not substandard in low-altitude performance.

A Soviet scientist now living in England reports that streamlining modifications introduced on the basis of tests made at TsAGI added 10% to the top speed of the aircraft. But when Soviet production facilities attempted to duplicate the aircraft their lack of skill in structural design and inferior tooling resulted in less efficient use of material and a structural weight increase of 12% for the same payload.

It should be noted that, since work of the more expert Soviet engineers is rigidly channeled into fields considered to be of first national importance, there is a marked difference in standards and achievements between the aircraft industry, whose operation we have seen to be on the whole quite efficient, and, say, the automobile industry, which any Soviet magazine picture proves to be backward indeed.

Lastly, it is our view that, although a long-range Soviet policy of industrial expansion in the future and the training of additional teachers should provide an increasing supply of engineers, and in particular reinforce the shaky base on which the Soviet engineering leaders are now perched, it is doubtful whether sufficiently general self-reliance in technical matters is likely to be developed without extensive changes in the entire Soviet approach to the problem of education.

This needle-nosed, stub-winged Lockheed F-104A Jet packs more punch per pound than any fighter ever built. Its Honeywell Transistorized Fuel Gage System weighs only 2-1/2 pounds complete with indicator-amplifier unit and two tank units. Despite its low power requirements this new gage is accurate to within 2% with any fuel load. Sub-miniaturized fuel measurement systems are another example of the way in which Honeywell Aero anticipates the instrumentation needs of modern jet aircraft.

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Let Amweld's Industrial Products Division study your problem in circular welded components. Better yet, send us your blueprints and then your production can be "well on its way with Amweld."

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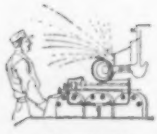

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TWO-STAGE SHOCK ABSORBERS fitted to ski landing gear of Stroukoff YC-134 pantobase assault transport aid later stability of narrow-tread gear and helps compensate for wide variety of surfaces from which the plane can operate. Soft first stage of the shock absorbers is soft and provides an effect similar to that of a tire, the second stage is stiffer. YC-134 is a development of the C-123.

Landing Gear Design Problems Solved

By Russell Hawkes

Cleveland—As airplane design moves into the realm of supersonics and maximum gross weights pass the hundred-ton mark, landing gear weight and size problems are assuming more and more prominence.

Not that efforts to minimize the weight and size of landing gear are new. A comparison of the DC-3 landing gear with that of any modern transport will show how the relative size of the gear has decreased, although it handles ever increasing loads and landing speeds.

But an even greater pace of improvement has been necessary as aircraft have become faster, heavier and more complex.

Problems include lack of space due to thin wings, crowded fuselages, more fuel; big weight differences in landing and takeoff; aerodynamic heating and proximity to jet engines creating the need for heat-resistant metals.

Developed Sealing Technique

Cleveland Pneumatic Tool Co., which has designed and manufactured the landing gear on perhaps half the big, fast airplanes in the country, is moving forward on some of these. One of its big accomplishments has been the development of a sealing technique which has raised the limits for landing gear by pressures so they bear greater loads.

Key to this phase is Static Permissible Cylinder Pressure, as expressed in the equation showing the factors involved in the landing gear problem:

$$\text{Shock Absorber Area} = \frac{\text{Percent Total Weight Supported} \times \text{Maximum Gross}}{\text{Static Permissable Cylinder Pressure}}$$

In this equation, Static Permissible Pressure was the limiting factor. Heretofore, it has not been increased (thereby increasing the size of piston and cylinder) because pressures greater than 1,000-1,200 psi. caused seals to leak and cylinder walls to fail. But Cleveland Pneumatic Tool developed sealing techniques which raised the static permissible pressure to 3,000 psi., using a variation of the standard "O" ring seal and to 8,000 psi. using a new type of packing gland. With a suitable beef-up of the piston face and cylinder walls the latter development reduced piston area eight-fold.

These seals are intended for use with the conventional oleo-pneumatic shock absorbers which are filled partially with air and partially with oil. The air, compressed by the weight of the airplane, acts as a spring. Oil damps out the bounce from the air spring as it flows through a metered orifice by slowing the reaction of the shock absorber. A tapered metering pin rising from the piston face and passing through the orifice increases the restriction of oil flow and stiffens the action of the shock absorber as it approaches the fully compressed position.

A "liquid spring" shock absorber, filled completely with oil, has been developed by Dowty Ltd. of England. It is based upon a mechanical packing gland capable of withstanding static pressures of 20,000-25,000 psi. This highly efficient shock absorber minimizes both diameter and length. The stroke is short because oil may only be compressed about 8% from its original volume. As a spring, oil has the advantage of a more nearly linear load-stroke curve than air. At compressed end of the stroke range the pressure rises more rapidly than volume sinks. This produces greater tendency to bounce past the equilibrium position.

Because of the short stroke of the liquid spring, a number of applications have the landing gear articulated to provide a mechanical advantage allowing the wheel more travel. Another benefit from the articulated gear is that the wheel moves aft in the first part of the compression stroke, thus absorbing some of the dynamic loads imposed by the sudden spin-up of the wheel from zero revolutions to landing speed at the moment of touch-down.

Licensed by Dowty

Small size permits the designer to build a light alloy landing gear leg around the shock absorber to take all loads perpendicular to the leg and free the shock absorber of all loads except that for which it is primarily intended.

Cleveland Pneumatic Tool has been licensed by Dowty as the exclusive American manufacturer of the liquid spring shock absorber. CPT predicts it will be widely used in American military aircraft. Currently, the only American

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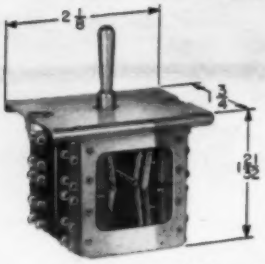
continuous developments by MICRO SWITCH specialists in aircraft switches MEET NEW SWITCH PROBLEMS OF THE INDUSTRY

HERE ARE A FEW EXAMPLES



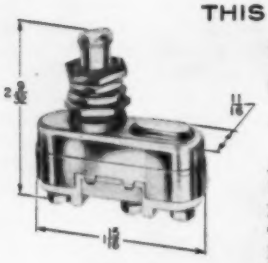
MULTIPLE CIRCUIT TOGGLE SWITCH MEETS PROBLEMS OF SIZE, WEIGHT, AND CAPACITY

Sixteen reliable, small-size MICRO subminiature switches are the components of this Type "AT" toggle switch. The switch was designed by MICRO SWITCH engineers for the control of 16 electrical circuits in a jet fighter.

The switches are single-pole double-throw and the assembly is operated by a single bat handle. Eight of the switches are operated with each direction of the toggle motion.

This entire 16-switch assembly is but 2-25/32" in height, including bat handle. It weighs 3.83 ozs.

(Send for Catalog 75a—"Subminiature Switches")



THIS HIGH TEMPERATURE SWITCH OPERATES RELIABLY FROM −50° TO +1000°F

Aircraft designers have found this switch an extremely dependable component for the increasing number of high temperature aircraft applications. Only laboratory-tested, heat-resistant materials are used in the manufacture of these switches. The switching element is mounted on a ceramic block and protected with a corrosion-resistant monel enclosure. This switch is available with pin plunger and roller plunger actuators, in addition to the panel mounting design shown.

This is a compact, lightweight, reliable precision switch capable of meeting a wide range of applications where the switch is exposed to extremely high temperatures. For example, as a signal switch located on a jet engine afterburner. Operates reliably in temperature ranges from −50°F to +1000°F.

(Send for Catalog 62—"Basic Switches")

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Its precise performance is constant whether ice-coated at −65°F or heated to +180°F. A thousand hours in salt brine spray or 30 days' operation at 104°F and 95% humidity still finds it going strong—and precisely. No chattering of contacts, no loosening of parts occurs during vibration tests of 10 to 500 cycles per second.

The MICRO "EN" is completely sealed, cylindrical in shape. Its performance gives a new concept for airborne switches.

(Send for Data Sheet No. 105)

THERE ARE ALWAYS NEW SWITCHES BEING DEVELOPED AT MICRO SWITCH

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Thus MICRO SWITCH frequently is able to come up quickly with a new switch, a new assembly or a new circuitry design that is a perfect solution to a complex problem.

There are many advanced switch designs being developed at MICRO SWITCH all the time. Some of them may easily turn out to be the switch you need.

It will cost you nothing to consult with MICRO SWITCH engineering personnel. If necessary we can develop an entirely new switch or switch assembly. Specialists are located at MICRO SWITCH branch offices in key cities. Call the one nearest you today.

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SIMULATION of landing gear contact with concrete runway is provided in this test rig, providing measurement of dynamic forces acting on landing gear structure and shock absorber. Wheels are driven to high speed by smaller motor-driven wheels (right) then slammed against concrete by drop press. Forward motion can also be duplicated.

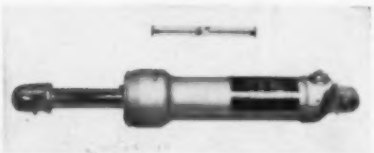
application on a production airplane is in the CPT designed articulated gear of the Lockheed F-104. It is more widely used in Britain and Canada. Foreign applications include the English Electric Canberra, both Hawker jet fighters, the Avro-Canada CF-100 all-weather fighter and the Fokker F-27 Friendship turboprop transport.

While the liquid spring shock absorber is most efficient, it does not necessarily provide the smoothest or softest ride. For this reason the oleopneumatic absorber is expected to continue in service where smoothness is more important and space is not so tight. This probably will include the heavy passenger carriers.

Weight Difference

A difficult problem in shock absorber design is posed by the vast difference in weight of a jet transport or bomber when it takes off full of fuel and when it lands with its tanks nearly empty. In non-stop transcontinental flights these planes will burn off at least 24 tons of fuel. A landing gear that would provide excellent shock absorption at heavy weights would be much too stiff at light weights. Conversely, a good shock absorber for light weights would bottom with the tanks full. A satisfactory compromise only can be reached by paying a weight and size penalty.

An approach being adopted by CPT is adequate for both ends of the weight scale and minimizes the penalty. The new approach is a "two-stage piston." The first stage is a relatively small piston with sufficient area to support the airplane at light weights. The second stage is a packing gland which is free to travel up into the cylinder with the first stage piston after the shock absorber has been compressed far enough for a ring on the piston barrel to pick up the gland. When the packing gland begins to travel with the piston, the piston face area is effectively increased.



IMPACT LOADS up to 60,000 psi. of piston area can be borne by this small liquid-spring shock absorber unit. Piston is attached to structure, cylinder moves with wheel.

Effect of Time

The Stroukoff YC-134 pantobase assault transport uses this type of shock absorber. Stroukoff engineers say the soft first stage provides some of the effect of a tire for the pantobase skis. They report that it also offsets lateral instability on the ground that results from the short coupling of the fuselage mounted skis. When a wing drops the low-side shock absorber stiffens as the second stage is picked up.

The demand for shock absorbers of higher efficiency, smaller size and therefore higher internal pressures has cre-

Engineers

Official United States Navy Photo

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ated a demand for ultra high strength steels to minimize the weight penalty of the beef-up necessary to cope with the high pressures.

Chrome-molybdenum-nickel steel (4340) now used in landing gear is heat treated to a strength of about 150,000 psi. It is possible to heat treat the steel to above 300,000 psi. but this reduces the ductility of the metal transverse to the grain and therefore its transverse tensile strength.

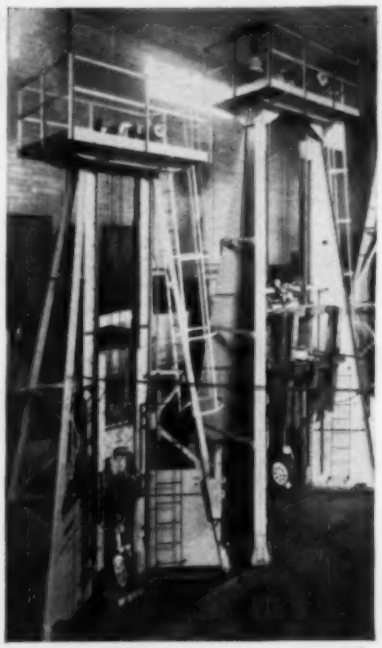
Because of this, the danger of failure under bursting stresses such as those encountered in a pressurized cylinder are increased. Heat treating to extremely high strengths also increases "notch sensitivity" (concentration of stresses at the edge of a notch, chip, or flaw). High notch sensitivity increases the danger of minor surface damage spreading and deepening and resulting in failure. A few steel companies are now cooperating in an effort to control the reduction in transversal ductility which takes place when the metal is extruded by varying heat treat temperatures in conjunction with changes in the chemical structure of the steel. Buyers requesting this control are specifying rigid and thorough-going inspection of output. Strips of steel cut transverse to the grain and shock absorber cylinders formed from the same billet of stock are heat treated together and the strips are pulled apart as a check on the quality of production. Cleveland Pneumatic plans to replace the test strips with rings which will be crushed as test specimens. It is believed this is a better measure of transverse ductility.

Machining Problem

Another disadvantage of ultra high strength steels is the problem of machining them. Constricted operations such as tapping holes less than an inch in diameter are especially troublesome because of the difficulty of designing carbide cutting tool mounts with adequate lateral strength in such a small space.

Steel heat treated to ultra-high strength also is more subject to embrittlement by hydrogen ions transferred to the steel when it is electroplated with cadmium to provide the extremely hard wearing surface that is desirable in shock absorber barrels. When heat is treated to lower strengths the steel retains enough ductility to make the electrolytic embrittlement unimportant. Baking of the plated steel drives out some, but not all of the hydrogen.

One solution to hydrogen embrittlement may be to replace cadmium plating with bake-on enamel plating. A disadvantage of enamel plating is that a crack or chip would permit corrosion to spread in the steel beneath the enamel. Cadmium plating is self-healing. Small



TWO OF THREE drop test rigs used by Cleveland Pneumatic Tool Co. to evaluate landing gears for a wide range of aircraft. Firm builds about half of landing gears used by major aircraft.

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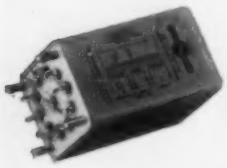

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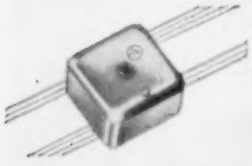

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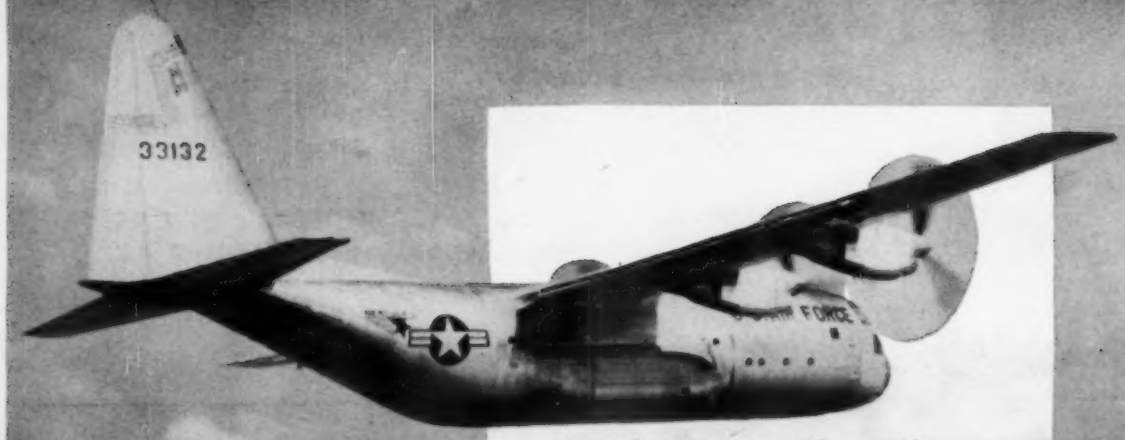


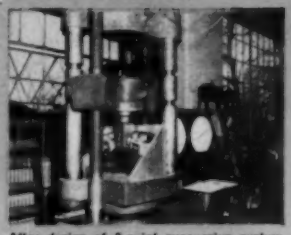
isolating vibration from 15,000 horses

Engine vibrations on the new Lockheed C-130A Hercules turboprop transport are effectively controlled by a LORD-designed Dynafocal® Engine Suspension. As a result, this multi-purpose Air Force combat plane produces greater comfort, safer operation with less structural wear.

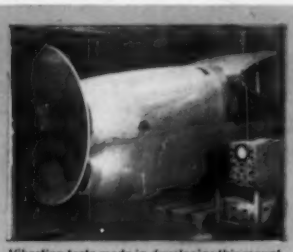
Each of the four Allison T-56 turboprop engines is suspended on a special LORD Dynafocal three-point mounting system. Bonded rubber mountings efficiently isolate vibrations developed by the 3,750 hp powerplants that weigh 2,778 pounds and have a thrust of 8,000 pounds.

Most of our modern aircraft rely on LORD mountings for increased passenger comfort and safety. These mountings are the product of LORD's research and engineering services which are available for the solution of your vibration problem. Call your nearest LORD Field Engineer or write the LORD Manufacturing Co., Erie, Pennsylvania.

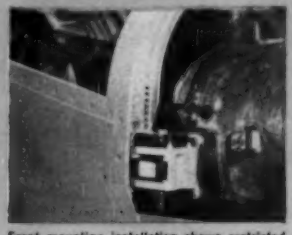
HOW LORD ENGINEERS TACKLED THIS PROBLEM



After design of 3-point suspension system, mountings were subjected to destruction tests on this equipment to determine yield and failure points. Rear mounting illustrated.



Vibration tests made in developing this mounting were performed with an actual Lockheed C-130A nacelle structure.



Front mounting installation shows restricted envelope limitations. C-130A develops 15,000 hp, uses 12 Lord mountings to control engine motion under all load conditions.

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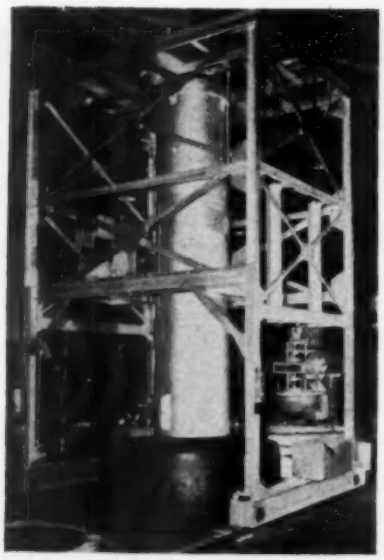
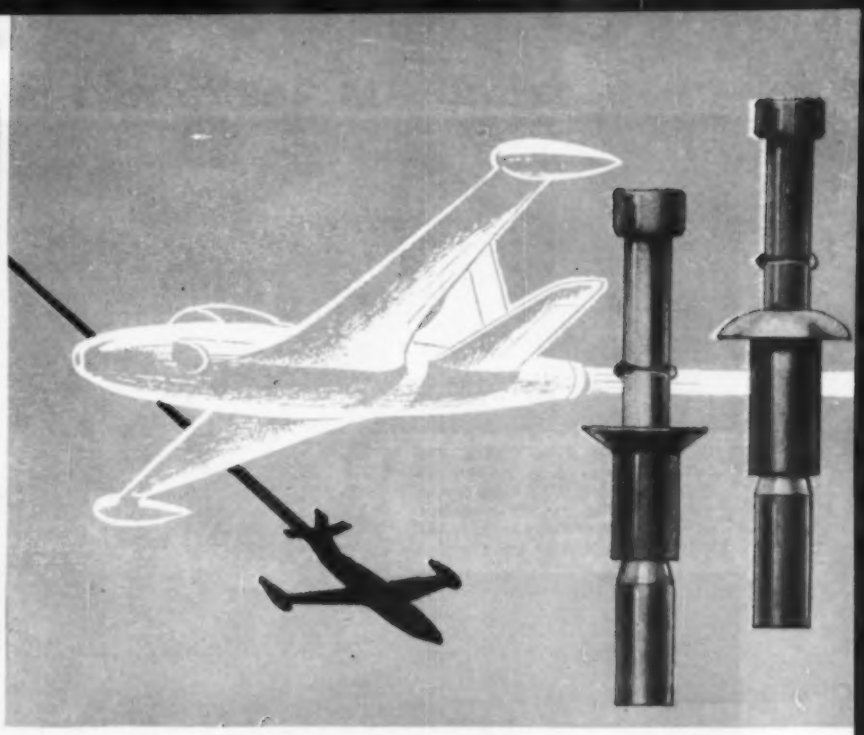


OIL QUENCH TANK tempers ultara high-strength steel used in Cleveland Pneumatic's landing gears. Steel has been heat-treated to strengths 310,000 psi. New materials are also handled.

breaks are soon filled and smoothed over with cadmium oxide.

Titanium, with its high strength-weight ratio and good retention of strength at high temperatures has long been considered as a possible replacement for steel in landing gears when production difficulties have been overcome. Titanium is easily galled, however, and a plating technique must be developed. Cleveland Pneumatic has developed a promising method of chrome plating by first applying a plating of nickel. Another company is developing a direct chrome plating process. Differences in thermal expansion between titanium and the plating are not expected to be a problem. Electroplating produces an alligator finish of tiny plates separated by microscopic cracks which allow thermal expansion without building internal stresses. The microscopic cracks also perform a valuable function by retaining minute amounts of lubricant.

The development of ultra high strength steels may limit the use of titanium to aircraft in which heat is a problem. Titanium is 60% as heavy and 68% as strong as steel heat treated to 220,000 psi. If steel can be heat treated to 260,000 psi and yet retain adequate transverse ductility, titanium will be only 57% as strong and the strength-weight ratio advantage will pass to steel. Aerodynamic heating of fighter planes now on the drawing boards is expected to be great enough to retemper ultra high strength steels to lower values of strength and ductility. For such applications commercially pure titanium is expected to be superior.



CHERRY "700" Aircraft Rivet

Gives More Effective Fastening

A new, more effective fastener for the aircraft industry has been developed and is now being produced at the Cherry Rivet plant in Santa Ana, California. Designated the Cherry "700," the new rivet provides a wide grip range, positive hole fill, high clinch, uniform stem retention and permits 100% positive inspection.

The "700" rivet is versatile and in many cases one length of each diameter will cover all thicknesses of material. Also, the sheet hole size is not critical as with other rivets since the design provides positive hole fill even in oversize holes. The stem always adjusts to fill the hole which affords high stem retention independent of hole size.

The manner in which the "700" rivet is set provides high clinch by drawing the sheets together tightly and uniformly. When the "700" rivet is set, the stem shoulder protrudes above the rivet head and gives visual indication that the blind upset is properly formed, the sheet hole is filled and the rivet is properly set.

This latest fastener advancement is a typical example of how the Cherry Division has paced the industry with new and improved fasteners and the tools and accessories for applying them—all of which are designed, developed and produced in the Santa Ana plant.

This plant is devoted exclusively to the manufacture of products for the aircraft industry.

For information, write for the new Cherry "700" bulletin to Townsend Company, Cherry Rivet Division, P.O. Box 2157-A, Santa Ana, California.

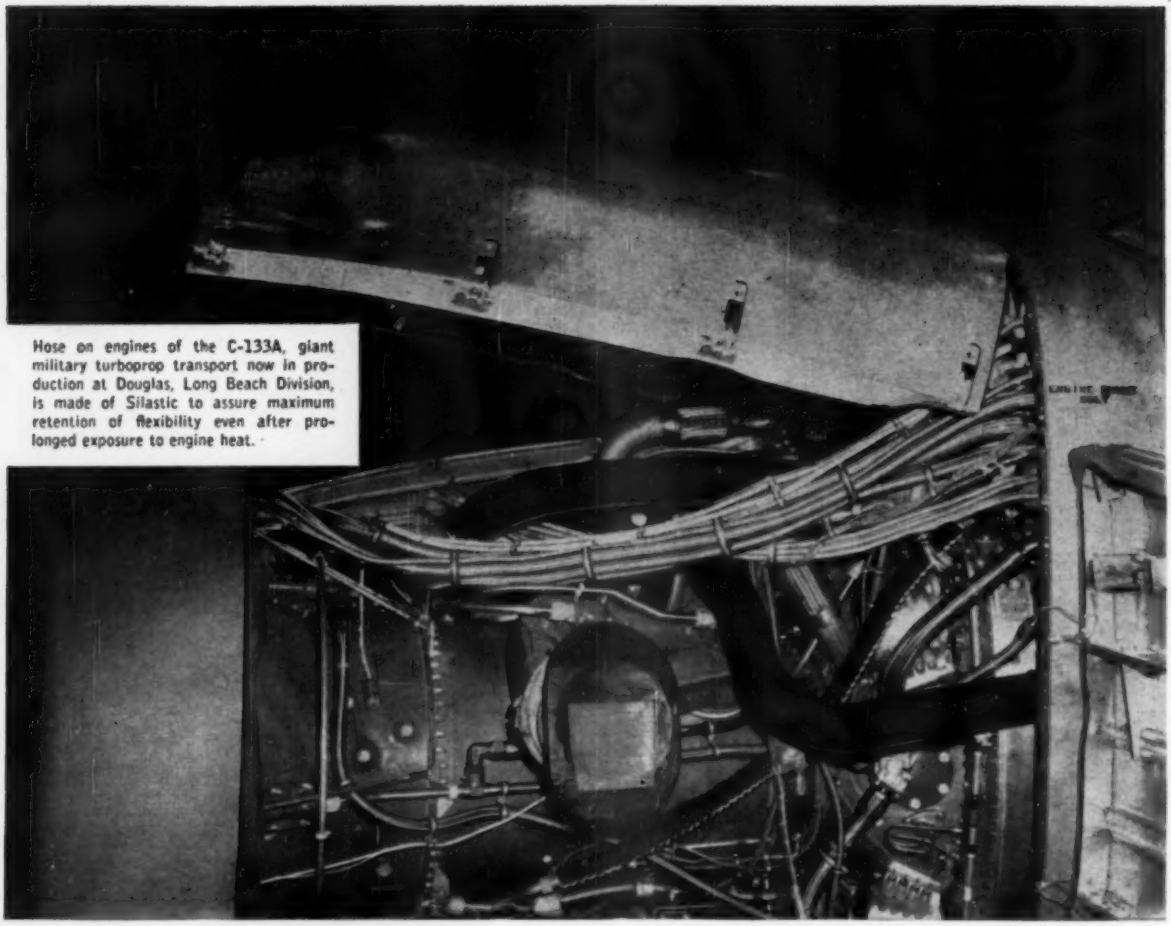
CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

Townsend Company

ESTABLISHED 1816 • NEW BRIGHTON, PA.

In Canada: *Parmenter & Bulloch Manufacturing Company, Ltd., Gananoque, Ontario*



Hose on engines of the C-133A, giant military turboprop transport now in production at Douglas, Long Beach Division, is made of Silastic to assure maximum retention of flexibility even after prolonged exposure to engine heat.

SILASTIC hose stays flexible at 500 F

SILICONE RUBBER

Whether the temperature registers −130 F or +500 F, Silastic* stays elastic . . . keeps its shape. That's why this versatile Dow Corning silicone rubber is ideal for jet engine hose, de-icing ducts, fuel tank ventilating hose and alignment couplings on jet engine tubing. Leading rubber companies fabricate Silastic hose, ducts and tubing in virtually any size, cross-sectional shape or color.

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Please send me the latest data on Silastic

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Typical Properties of Silastic for Hose, Ducts and Tubing

• Temperature range, °F	−130 to 500
• Corrosion	Non-corrosive to metal
• Pressure range	Low pressure
• Oil resistance	Dependent on type of oil

• Light weight • Weather resistant • Flexible

*T M REG U S PAT OFF.

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

first in silicones — DOW CORNING SILICONES

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

FLAME-PROOF FABRIC CONNECTOR ELIMINATES "fire zone" fatigue

CASE HISTORY

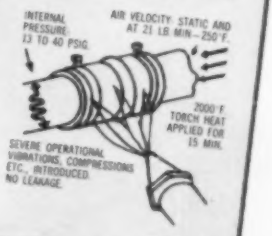
ARCOSIL RUBBER IMPREGNATED FIBERGLASS CONNECTOR PERFORMS AFTER 2000° FIRE TEST

To eliminate fatigue failures of metal connectors on aircraft supercharger intake ducts, Arrowhead designed a replacement part from ArcoSil silicone rubber fiberglass material. Tests were made to determine fire-resistant and fire-proof characteristics of supercharger inlet duct connector.

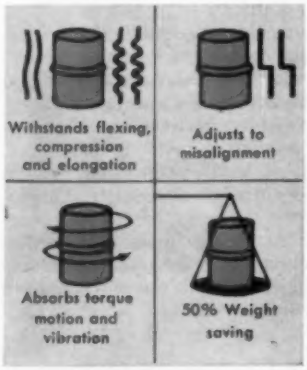
TEST CONDITIONS: Required to withstand 2000° F. flame for 15 min. Pressure: 13 PSIG. Internal air flow: static and 21 lb./min. at 250° F. internal air temperature.

RESULT: After severe flexing, conductor withstood 40 PSIG pressure with no leakage.

C.A.A. APPROVED.


INTERNAL PRESSURE, 13 TO 40 PSIG.
AIR VELOCITY: STATIC AND AT 21 LB. MIN.—250° F.
2000° F TORCH HEAT APPLIED FOR 15 MIN.
SEVERE OPERATIONAL VIBRATIONS, COMPRESSIONS ETC., INTRODUCED.
NO LEAKAGE.

ArcoSil connector replaces metal on supercharger intake duct


Withstands flexing, compression and elongation
Adjusts to misalignment
Absorbs torque motion and vibration
50% Weight saving

ARCOSIL FIBERGLASS DUCTING OFFERS *NEW* DESIGN APPLICATIONS

New techniques developed by Arrowhead in fabricating complex ducts, sleeves and couplings from ArcoSil flexible silicone rubber impregnated fiberglass have opened amazing new design possibilities. In addition to ArcoSil's ability to withstand heat, vibration and torque-motion-fatigue, the materials permit the parts to be formed to almost any conceivable shape and size to meet individual specifications.
A variety of standard constructions offers serviceability under extreme high and low temperatures and at various pressures.

Close tolerance tooling and production costs are cut to a fraction, as compared with metal, to effect sizeable savings in either experimental or production quantities. Up to 50% weight reduction is possible.
Flexibility permits crushing without damage and simplifies installation.

Arrowhead specializes in solving difficult flex-connector problems in fuel, oil and air systems. Arrowhead field engineers will gladly provide further information and assistance.

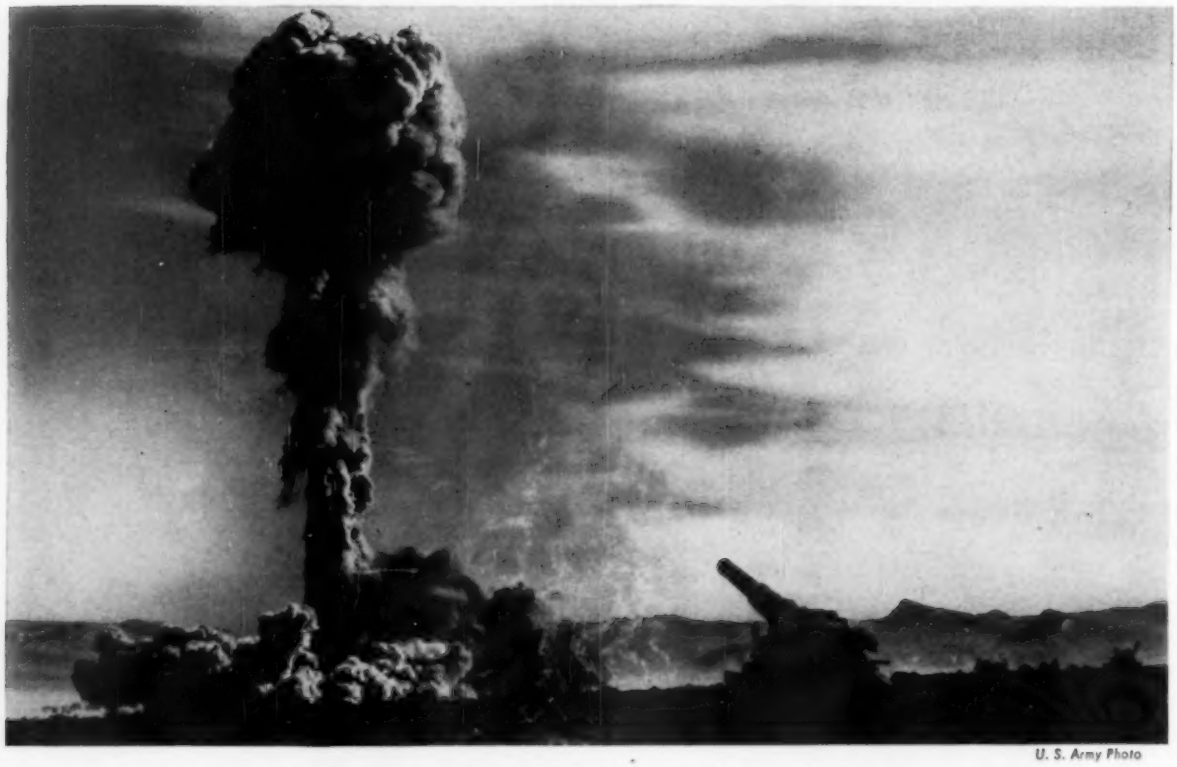
WRITE FOR ENGINEERING BULLETIN
describing complete line of ducts, sleeves and couplings.

Many types and sizes

ARROWHEAD RUBBER COMPANY
Division of National Motor Bearing Company, Inc.

2330 CURRY STREET, LONG BEACH, CALIFORNIA

Pioneer fabricators of silicone rubber; Originators of rubber-fiberglass ducting and manufacturers of stainless steel ducting components.



U. S. Army Photo

Firing of 280 mm Atomic Shell at Las Vegas Proving Ground in May, 1953. This shell was designed jointly by Picatinny Arsenal and Los Alamos engineers and scientists.

ARMY ATOMIC MUNITIONS ARE BORN AT PICATINNY ARSENAL

Picatinny Arsenal at Dover, N. J., is composed of a group of Ammunition Development Laboratories responsible for Army ammunition technical development. Its responsibilities include research and development of ammunition for artillery, mortars, and recoiless rifles, mines, grenades, warheads for bombs and guided missiles, and rocket propellants.

One of Picatinny's principal laboratories is the Atomic Applications Laboratory, which is responsible for Army research and development of atomic munitions. This Atomic Applications group operates as the nerve center for all activities in atomic development for the Department of the Army.

To execute its mission responsibility, the Atomic Applications Laboratory draws not only on its "in-house" capabilities, but on the facilities of other Army arsenals, proving grounds, and on industry. Its "in-house" capabilities include an engineering technical organization that uses the full facilities and capabilities of the arsenal.

As well equipped as it is to solve the multitude of complex technical problems which confront it, Picatinny Arsenal has no greater asset than the long years of accumulated experience and unfailing loyalty of its career government employees. A recent example of its effectiveness is the crash program which resulted in the 280 mm Atomic Shell.

Picatinny's technical capabilities are utilized basically in expanding the frontier of mechanical, electrical and explosive development.

The scientific personnel in organizations such as the Atomic Applications Laboratory will determine America's ability to meet potential aggressors with the most effective Atomic Weapons possible.

This is one of a series of ads on the technical activities of the Department of Defense

198

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Lockheed F-104 Uses Stability Unit

Santa Monica, Calif.—To increase its useful top speed and ceiling, Lockheed's F-104 Starfighter incorporates a Lear designed and built 3-axis stability augmenter. The feature has been part of the F-104 design thinking since the plane's very early stages. Stability augmentation is required to take advantage of a Mach 1.5-and-over capability, and the F-104 is the first production fighter with the feature included from preliminary design thinking onward.

Lear Role

Specifications, design parameters and stability requirements were laid down by Lockheed, which also furnished servo controls and actuators. Avionic components were designed by Lear's IPCAL, the California-based design unit of the company's Instrument Products Division at Grand Rapids, Mich.

The engineering group is located on the West Coast for proximity to contractor-customers and USAF's Flight Test Center at Edwards AFB.

Highlights of the Lear portion of the system are:

- Complete transitorization, using silicon transitors and diodes.
- All printed circuitry.
- Plug-in boards for the six channels of the system, each board incorporating its own printed circuitry-transistorization.
- New miniaturized rate gyros for sensing displacement.
- The entire unit packaged in a magnesium casting 12x18x5.75 in.
- A total avionic component weight of 18 lb.

Although the system currently makes use of six information channels, eight can be used.

Constant Operation

The system operates at all times, cannot be turned off by the pilot. However, monitoring channels are provided for fail-safe operation, to preclude excessive accelerations which could exceed the aircraft's load factor limits. This provision for the system was a Lockheed requirement.

The Lear system spanned one year from conception to delivery of the prototype. First thinking was in terms of a yaw damper, which was soon expanded to 3-axis stability augmentation, and provision in the aerodynamic envelope and systems design was made for this equipment.

The Lear portion of the stability augmentation stops at electrical signal output to the control and servo system valves, all part of Lockheed's design.

Essentially, the stability augmentation system is the two inner of the four loops of an automatic flight control system, being the loops for the control surface positioning and body stabilization about its own axis. The two outer loops, attitude stabilization (relation of the plane's position to earth) and flight control (navigational tie-in), Lear engineers feel, could be added to the current system to provide both stability augmentation and automatic flight control (autopilot) without too great structural and systems revision, and with less weight than two separate systems.

The Lear system is the first transitorized stability augmentation system, and was thoroughly tested by Lockheed's California Division research laboratory prior to installation in the Starfighter.

Problems of High Speed Flow Discussed in Text

"Supersonic Inlet Diffusers," is the first text exclusively devoted to the important problems of getting flow into high speed aircraft without suffering prohibitive propulsive losses. Author Dr. Rudolf Hermann introduces his

WHEN YOU'RE ON FIRST.....

You've got to be good!

MARTIN SEAMASTER...

FIRST

Multi-Jet Attack Seaplane

HARTWELL

FLUSH TOGGLE

HOOK LATCHES... FIRST.....

to conform to applicable specifications for power packs and nacelle.

Before choosing your flush latches and hinges, just ask yourself one question... *who was on first?* HARTWELL equipment is used by every major aircraft manufacturer because it is designed for application.

Visible in inset are ten specially designed convex latches mounted on one of four engine pod cowlings. The toggle mechanism locks in place and applied load holds the flush latch closed. Simple tee-bolt and trigger opening action.

Produced to exacting aircraft requirements and delivered *quickly, efficiently,* and *economically.*

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Manufacturers of Aircraft Flush Latches and Hinges, Fittings and Cable Terminals. New 72 page, 2-color Catalog illustrates and gives full details of complete line.

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TOMORROW'S AIRCRAFT: *One step closer*

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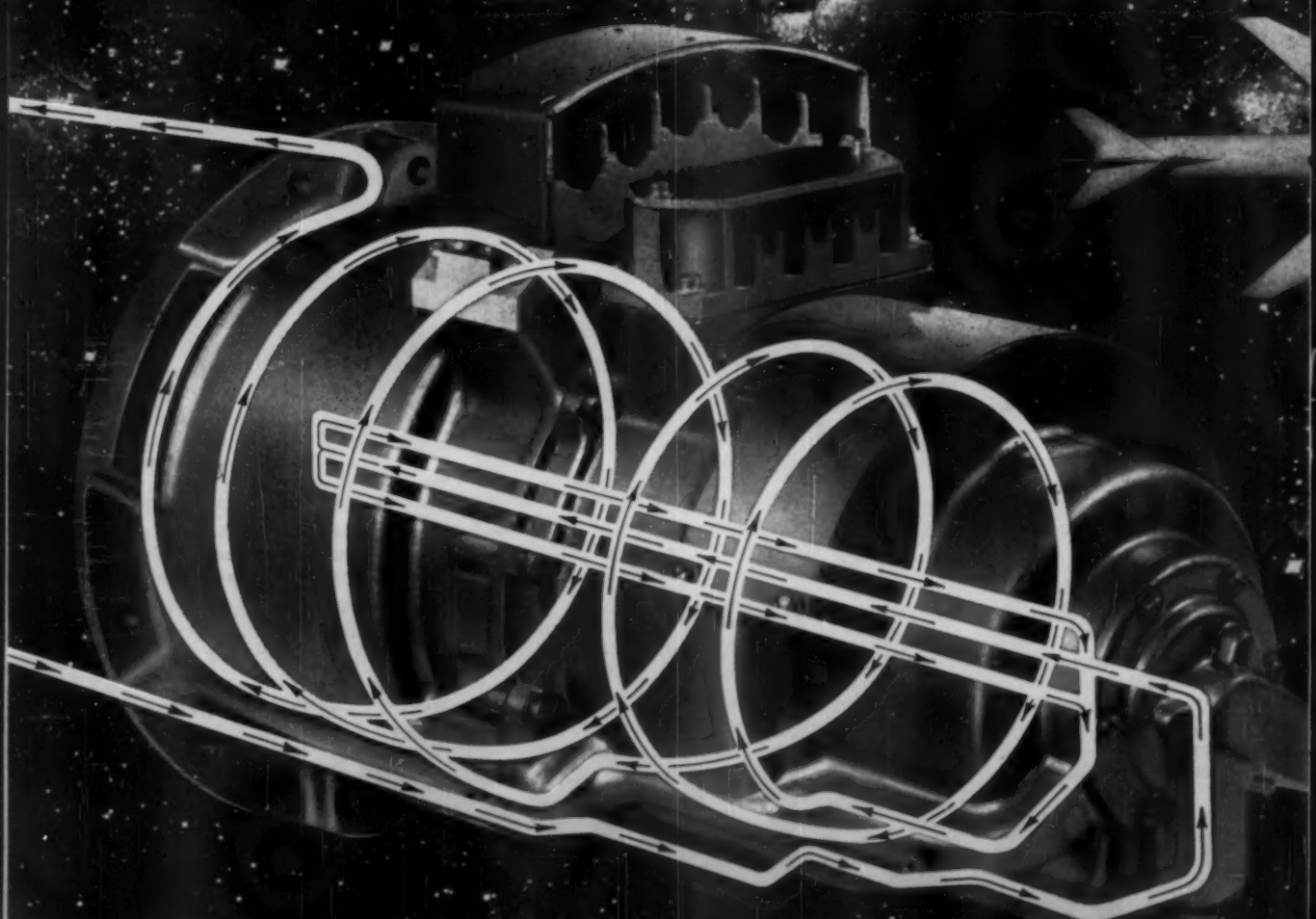
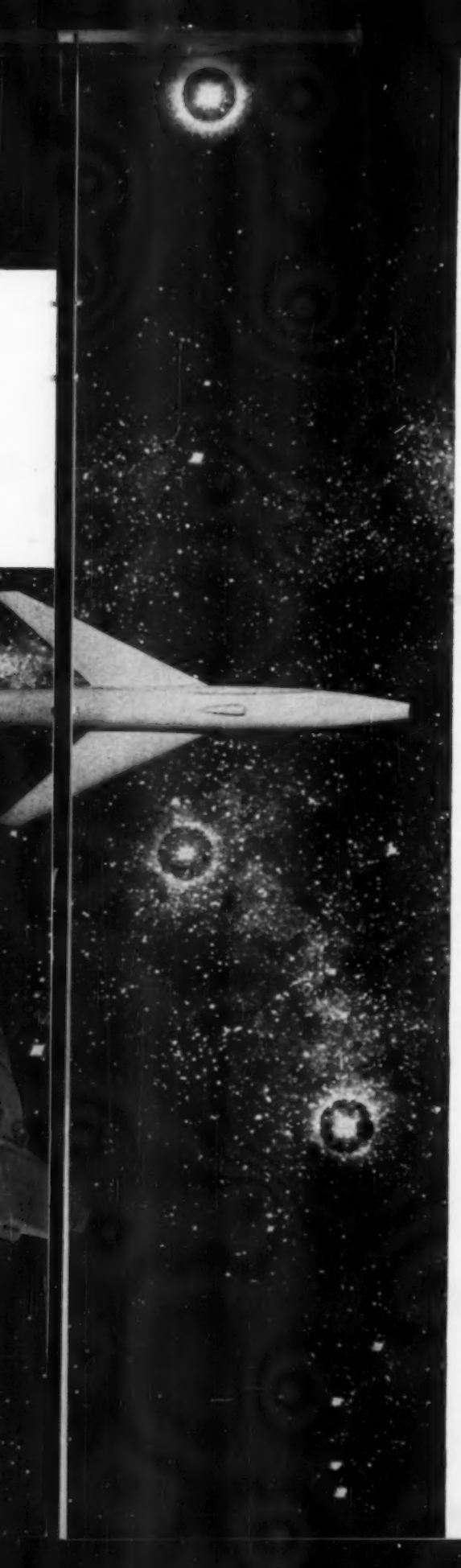
Power without problems





This revolutionary a-c generator is cooled and lubricated by engine oil . . . has no brushes, slip rings, commutator or grease-lubricated bearings . . . gives superior performance.

Westinghouse research in the field of semiconductors produced the high-temperature silicon diodes that are the key to the operation of this new generator. A-c power generated in the exciter armature is fed into the silicon rectifiers mounted on the generator shaft. The resulting d-c output supplies the main rotating d-c field.

Without brushes, aviation gas turbine engine oil can cool and lubricate the generator. Oil is pumped through the generator shaft, through tubes in the frame casting, and is used in the hydraulic constant-speed drive. All heat picked up by the oil is dissipated in the engine oil cooler. The generator operates safely with engine oil at temperatures up to 300 degrees Fahrenheit. All the usual generator trouble spots are eliminated—no brushes or commutating parts to wear, bearing lubricant is continuously replaced.

This is the first generator that is completely integrated with its drive, with the engine oil cooling system and with the balance of the electrical system. It is completely enclosed; there are no air tubes or ducts to occupy space and clutter up the airframe; all external oil seals are static and there is no overboard drainage of oil. No additional plumbing is required because the extension of the engine oil lubricating system is all internal. Now—aircraft altitude and speed will no longer be limited by the electrical system—a big step toward helping you bring tomorrow's aircraft . . . one step closer. J-91024-B

J-91024

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Now...One Hole Mounting Lever Lock Switches

These new Cutler-Hammer One Hole Mounting Lever Lock Switches are available in constructions to prevent inadvertent operation from any lever position to any other lever position. Intentional operation of the switch is accomplished by a pull on the lever to unlock it and permit its movement to the desired position.

Another Cutler-Hammer "first" for Aircraft Designers

Cutler-Hammer now offers the first line of Lever Lock Switches ever engineered for one hole mounting. Lever Lock to prevent accidental operation *without* cumbersome switch guards that obstruct panel visibility. One Hole Mounting to conserve panel space and provide maximum areas for panel markings.

These are typical Cutler-Hammer Aircraft Switches . . . top-quality construction, expertly engineered. Positive snap action with dependable contact pressure in the closed position and reliably secure contacts in the open position even under the severe shock and vibration encountered in combat aircraft service. The lever seal is of special silicone rubber, engineered to outlast the operational life of the switch. The seal is unaffected by ozone or sunlight, oil or water, or extreme temperatures, either high or low.

Cutler-Hammer Lever Lock One Hole Mounting Aircraft Switches are available in single, double or four-pole constructions . . . single or double throw, with or without center "off" position. Designed for minimum parts and weight. They solve many aircraft design problems. Be sure you have complete data *now*. Write or wire today.

CUTLER-HAMMER, Inc., 1471 St. Paul Ave., Milwaukee 1, Wisconsin.

What you should know about Cutler-Hammer

Cutler-Hammer has long held the respect of the aircraft industry because this company has been *part* of the aircraft industry for 35 years. It has never been an opportunist supplier. It has *pioneered* the designs others have followed. It has sought to serve, not merely sell. It has been in the forefront of all cooperative activity in standardization and long-range planning. It has supplied complete lines of equipment, not merely the items of widest use and most profitable manufacture. Today, as for the decades past, Cutler-Hammer engineers are working closely with the aircraft industry's leaders . . . thinking ahead, planning, designing and building for the future. Here is the record:

1920 Cutler-Hammer designed and manufactured the first line of switches ever created specifically for use in aircraft.

1938 Cutler-Hammer designed and manufactured the first d-c power relays ever created specifically for use in aircraft.

1943 Cutler-Hammer designed and manufactured the first a-c power relays ever created specifically for use in aircraft.

1949 Cutler-Hammer started development of the first environment-free power relays for use in aircraft.

1953 Cutler-Hammer submitted samples and certified test reports on the first hermetically sealed power relay to WADC and Bu. Aer. Cutler-Hammer configuration was adopted as industry standard by ASG.

1955 Cutler-Hammer designed and manufactured the first one hole mounting Lever Lock aircraft switches.

CUTLER-HAMMER
AIRCRAFT CONTROL
C-H

subject by comparing aircraft inlets to supersonic wind tunnel diffusers. Because slowing down flow from supersonic to subsonic Mach numbers in each case can rob the system of so much energy, this process has become one of the foremost aerodynamic subjects of our day.

Hermann reinforces the mathematical development of inlet theory with illustrations and photographs of typical inlet configurations. He ends up his book by touching on the complexities of "buzz" phenomena wherein the shock won't stay put but oscillates back and forth between being progressively swallowed by the inlet and being rapidly disgorged.

Supersonic Inlet Diffusers and Introduction to Internal Aerodynamics, by Dr. Rudolf Hermann, $16, Minneapolis-Honeywell Regulator Co., Minneapolis 13, Minn.

Cloud Seeding

Australian airborne meteorological research equipment inventory includes silver iodide generator (above) used to seed clouds with hygroscopic water drop and ice crystal nuclei in weather modification experiments. Airfoil shaped device (below) is indicator of liquid water content of clouds and may be used to determine when cloud is ripe for seeding. Instruments are mounted on a Royal Australian Air Force DC-3.

VIBRATION AT WORK...

Service-vibration duplicated in COMPLEX MOTION testing!

This is something *new* in vibration testing! Specimens are subjected to the same kind of "noise," or complex vibrations, as that encountered in actual service.

Net result: It gives a truer picture of what happens to components, promotes greater reliability.

MB has designed complete vibration exciter systems to fulfill the special needs of random motion testing . . . and virtually any other test specification as well. Shaker, power supply, control equipment are all integrated into a matched, high fidelity system.

If you have any questions on vibration testing at all, you can't do better than coming to a leading authority on the subject . . . the MB engineering staff.

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. . . TO EXCITE IT . . . TO MEASURE IT

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advancement in instrument design

COMPACTNESS
IN AIRCRAFT INSTRUMENT MECHANISMS
(moving coil)

MEP-2-D Mechanism

Mechanism design for complex, multi-element aircraft instruments poses the dual problem of drastically reducing size without impairing performance or durability. Marion's MEP-2-D Coaxial* Mechanism — an entirely new mechanical design concept — provides greater durability and stability than many larger, heavier mechanisms. Flexibility of use is typified by Marion AN3C-series 1, 2, 3, and 4 element instruments. Engineered specifically for airborne use, the MEP-2-D is added proof of Marion's contribution to improved indicating and control systems for aircraft.

*Trademark for the basic Marion moving coil mechanism. Patents Pending.

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MEDALIST
marion electrical instrument company
GRENIER FIELD—Manchester, N. H., U.S.A.
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marquardt AIRCRAFT CO.

P. O. Box 2013, Van Nuys, California

Allison Turbo-Liner, refitted with prototype 501 turboprop engine, is flying again.

Allison Turbo-Liner Has New 501 Engines

Allison's Turbo-Liner, back in the air after refitting with a pair of prototype 501 commercial turboprops, is clocking speeds approaching the 400-mph. mark and touching altitudes above 33,000 ft.

The flying test bed for the company's turboprop powerplants had its original T38 engines replaced with the commercial 501s during a seven-week down period starting last April 2. Power jump is from the 2,925 eshp. per T38 to 3,750 eshp.

New exhaust system and aft nacelle were designed around the new engines, and the fuel system was modified to use kerosene, the intended fuel for the Lockheed Electras that will use the 501 engines.

Reduced rpm. for ground idle and taxi operations is a feature of the 501 engines, adapted in response to suggestions of the airlines and other customers that less noise on the ground would be a welcome dividend. Ground rpm. is now at 10,000 instead of the engine full revs of 13,200.

Sound reduction at 50 ft. from the prop is 6-8 db., a worthwhile figure.

Top speed of the Turbo-Liner is 396 mph. at 15,000 ft. Rates of climb as high as 1,000 fpm. have been measured at 25,000 ft. In addition, the plane has been climbed to 33,500 ft. at maximum climb power in locked-throttle condition, without variation in engine temperature. This is about 10,000 ft. higher than any commercial Convair-Liner has ever flown.

Air starts have been made at altitudes up to 30,000 ft.

Next scheduled change to the Turbo-Liner will be made this month, when new four-bladed Acroproducts props will replace the present three-bladed ones, and the prototype engines will be brought to Electra configuration.

Redesigned exhaust reduces ground noise.

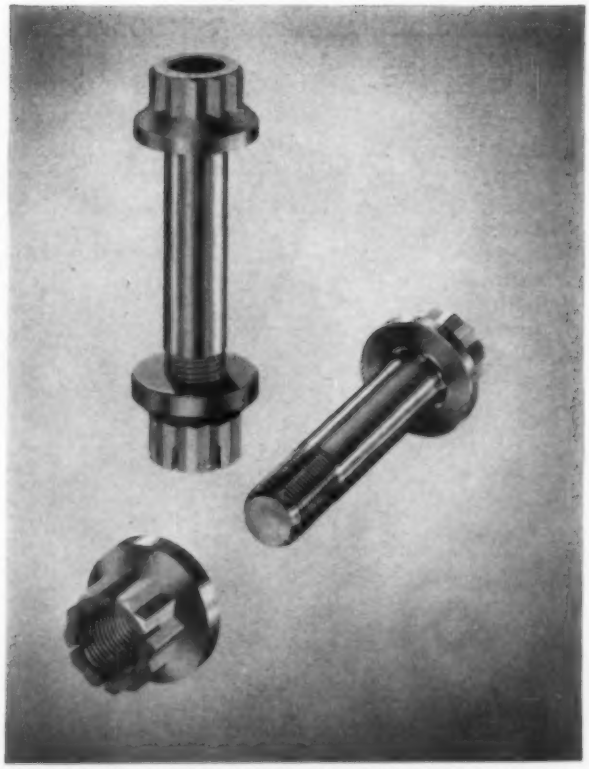
American Machine Dedicates R&D Center

Pacoima, Calif.—New research and development center primarily devoted to accessory power supplies for guided missiles was formally dedicated here at American Machine & Foundry Co.'s Turbo Division.

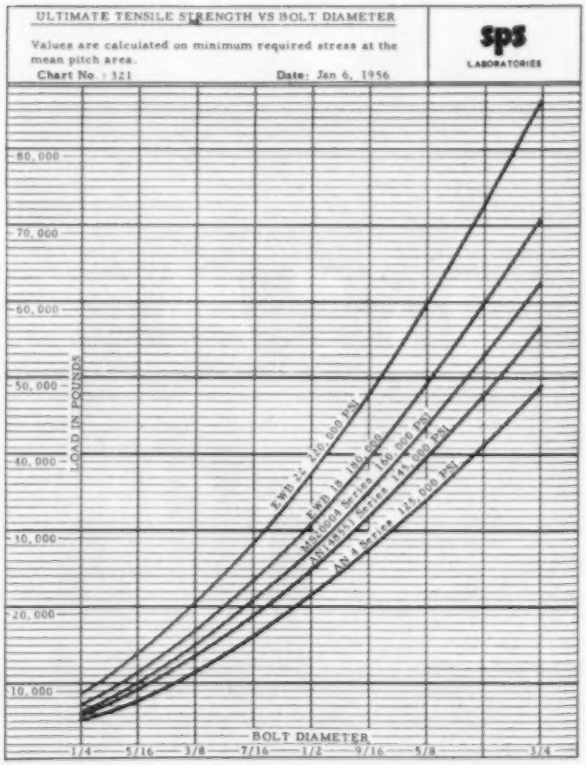
New facility includes a 31,000-sq. ft. engineering building and a 36,000-sq. ft. test area which encompasses a department for experimental fabrication and assembly of accessory power supplies.

Turbo Division, which is a contractor to the Air Force to develop and manufacture accessory power units for the Convair ICBM Atlas, also has its equipment in the Douglas-built Nike, Sperry Sparrow, Convair's Terrier, and several drones.

In addition to work on propellants, feed systems, gas generators, turbines, high frequency alternators, speed and voltage controls, and hydraulic pumps, the research activity is engaged in studies of fundamental rocket research, rocket motor scaling, nonpropellant reaction chambers, anti-coking additives, and application of cermets to turbine wheels.



EWB-22 bolt is entirely new. External wrenching head with increased bearing area permits greater loading without indentation of bolted surface. New Hi R thread form, generous fillet under head, smooth overall surface increase tensile and fatigue strength. The EWN-22 locknut was designed with characteristics specially suited to the bolt.



Build stronger, safer, lighter airframes with new SPS Hi Psi aircraft bolts

Conventional bolts were not strong enough to fasten jet-age aircraft now on drawing boards. So Standard Pressed Steel Co. discarded obsolete fastener configurations, materials and production techniques and designed a new high-strength bolt—the Hi Psi EWB-22—which is the strongest bolt made to this time.

Compared with conventional 160,000 psi bolts like the MS 20004 Series, the SPS EWB-22 has 38% greater tensile strength and, at 8 million stress cycles, up to 90% greater fatigue strength. These qualities make it feasible, in most cases, to replace a standard MS 20004 Series bolt with an EWB-22 *of the next smaller diameter*. The benefits from use of the EWB-22—in increased structural strength and security and in reduced weight—are obvious.

Concurrently with the development of the EWB-22, SPS produced the Hi Psi EWN-22 locknut to complement the bolt. It is a high tensile strength self-locking nut with a 12-point external wrenching surface. It makes possible the high wrenching torque needed to preload the EWB-22 to the greatest advantage.

Along with Hi Psi EWB-22 bolts and EWN-22 locknuts come other new additions to the complete SPS line of threaded aircraft fasteners—PLI-22 preload indicating washers, simple mechanical devices for accurately preloading the new high strength bolts. For detailed information about these products—or about your special aircraft threaded fastener problem—write us today. Aircraft Products Division, STANDARD PRESSED STEEL CO., Jenkintown 3, Pa.

AIRCRAFT PRODUCTS DIVISION

STANDARD PRESSED STEEL CO.

sps

JENKINTOWN PENNSYLVANIA

EWB-22 is much stronger than conventional aircraft bolts. These curves, with ultimate tensile strength in pounds plotted against bolt diameter, show that it is feasible to replace an MS 20004 bolt with an EWB-22 one size smaller. The EWB-22 is stronger in shear and in fatigue as well.

Career Pilot

MAJOR HUBERT D. GADDIS
" a man of firsts "

For 14 years, Major Hubert D. Gaddis has been an Army aviator, beginning in 1942 as a private in the liaison pilots course, one of the very first classes offered in Army Aviation.

After airborne service in Europe, he attended Bell Aircraft's first helicopter mechanics course, and in 1947, graduated from Bell's first helicopter pilots' school. The following year, he organized the Army's first rotary wing pilot training at Fort Sill.

Oklahoma-bred Maj. Gaddis went to Korea as commanding officer of the 8191st and 8192nd Army Helicopter Evacuation Units and of the first helicopter medical evacuation company.

Major Gaddis is currently director of the Rotary Wing Section of the Army Aviation Center, Fort Rucker, Ala. He is an Army Career pilot, the best kind of help and guidance for the Army's new aviation cadets.

In order to accomplish its airborne missions, the Army needs aircraft capable of operating from whatever areas are available at the front lines. The helicopter provides this capability and the Army trains its personnel to take the fullest advantage of the unlimited utility of rotary wing aircraft.

Helicopters need pilots and mechanics!
Apply to Army Aviation for career training!

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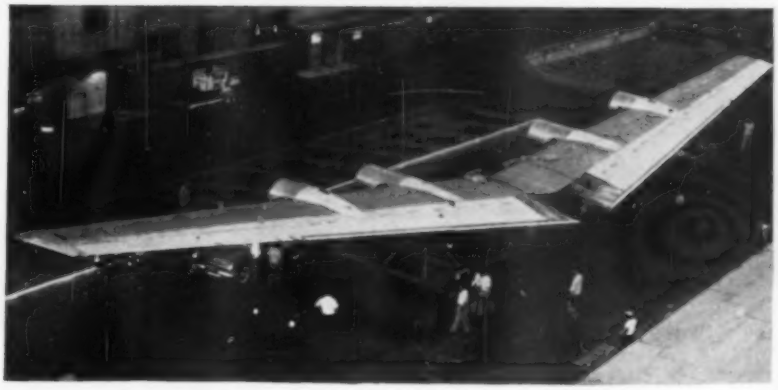
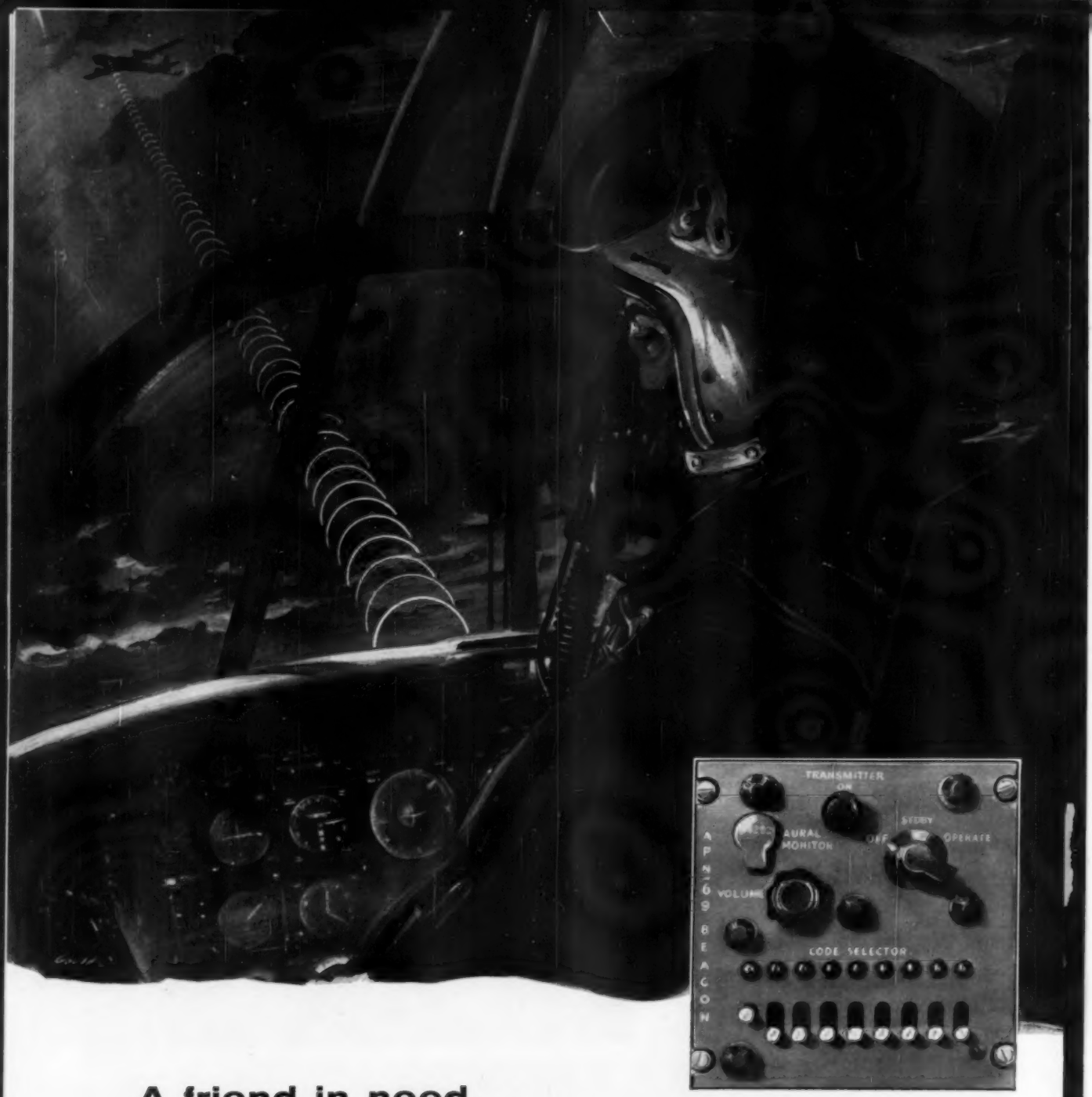
FT. WORTH, TEXAS

Record-Size Wing Mated to Fuselage of Lockheed 1649A



Twenty ton overhead crane (top) lowers 116 ft. fuselage of Lockheed 1649A Super Constellation onto cradle where 150 ft. wing will be raised and fitted into slot on underside of the fuselage. Wing, 23 ft. longer than those on present Super Constellations, is described by Lockheed as the longest span of any transport. NACA airfoil is one-sixth thinner than existing Constellation wings, with an aspect ratio of 12 compared with present 9.12. Dolly (center) holds wing as Lockheed crew tows it between final assembly hangars for tank sealing. Tanks hold 9,600 gal. for range of 6,400 mi. Drawing (left) visualizes completed airplane, christened Super Star Constellation.



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A bomber pilot, homing on a tanker when his fuel is low, might well thank, not his lucky stars, but his AN/APN 69 . . . a radio beacon built by Stromberg-Carlson.

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- Shortens processing cycle with existing exposure technics.
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An important factor contributing toward making the Forrestal "the most powerful ship ever built" is the dependably accurate Automatic Gun Fire Control system which guides the fire of its anti-aircraft guns. Designed and built by the Reeves Instrument Corporation in conjunction with the U. S. Navy Bureau of Ordnance, this equipment, service tested on the USS FORRESTAL, has since been installed on its sister ship, the USS SARATOGA.

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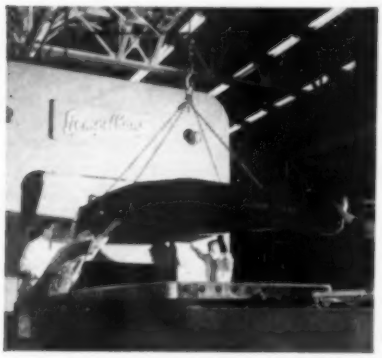
PRODUCTION BRIEFING

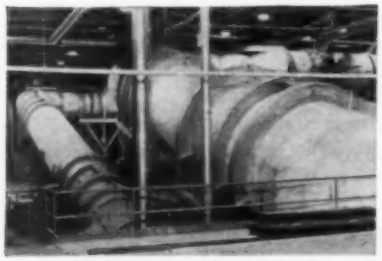
The rubber pressure pad about to be inserted in Avro Aircraft Ltd.'s new 15,000 lb. forming press will bring 4,000 psi to bear on parts of CF-105 supersonic delta fighter, Avro says. Said to



be the largest of its kind, the Canadian firm's press was designed and manufactured by the Siemelkamp Co., Germany. It can mold thick sheets of light metals in one minute cycles.

Stauffer Chemical Co., is expanding its boron trichloride production facilities at Niagara Falls, N. Y., ten times to be able to ship tank car quantities of chemical, an essential base for the manufacture of high energy fuels and missile propellants.

More than 65,000 sq. ft. of spun mineral wool blankets sound and heat insulates NACA's 100,000 hp supersonic wind tunnel at Langley Aeronautical Laboratory, Langley Field, Va. The 3½ in. thick insulating blankets are held 2 in. away from the outsides of the tunnel walls so that they act as sound

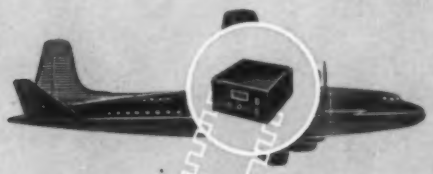


as well as heat transmission suppressors. The result has been that the heat transfer has been cut down from 1,100 to 30 btu sq. ft. hr. and the noise has been reduced 30 db. C. E. Thruston & Sons, Inc., Norfolk, Va., performed the work using blankets manufactured by Baldwin-Hill Co., Trenton, N. J.

General Motors Corp. and the Texas Co. (Texaco) have both expressed confidence in the future of the free-piston engine for surface transportation and industrial uses. Both have been experi-

Identification of Aircraft

RR

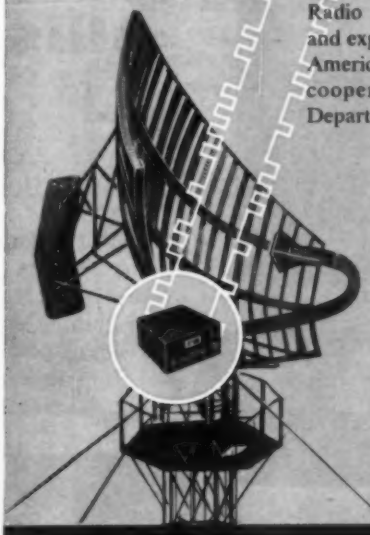


RADIO RECEPTOR

Develops a new series of Pulse Coders and Decoders

Under the sponsorship of Army Signal Corps Laboratories, Radio Receptor Company has developed a new group of pulse coders – decoders, to aid in aircraft identification. Advancing the state of the art in transistor application coupled with efficient circuitry and mechanical design, these new units are capable of performing many more functions than similar equipments, with added savings of more than 60% in size and weight.

This is yet another example of how during 34 creative years, Radio Receptor has utilized its skills and experience in electronics to further America's military might through close cooperation with all arms of the Department of Defense.



Some of the advanced techniques Radio Receptor has employed in this new development include:

- *Diode switching.*
- *Fast precision pulses.*
- *Transistorization with high reliability.*
- *Subminiaturization.*
- *Remote control.*
- *Digital techniques.*

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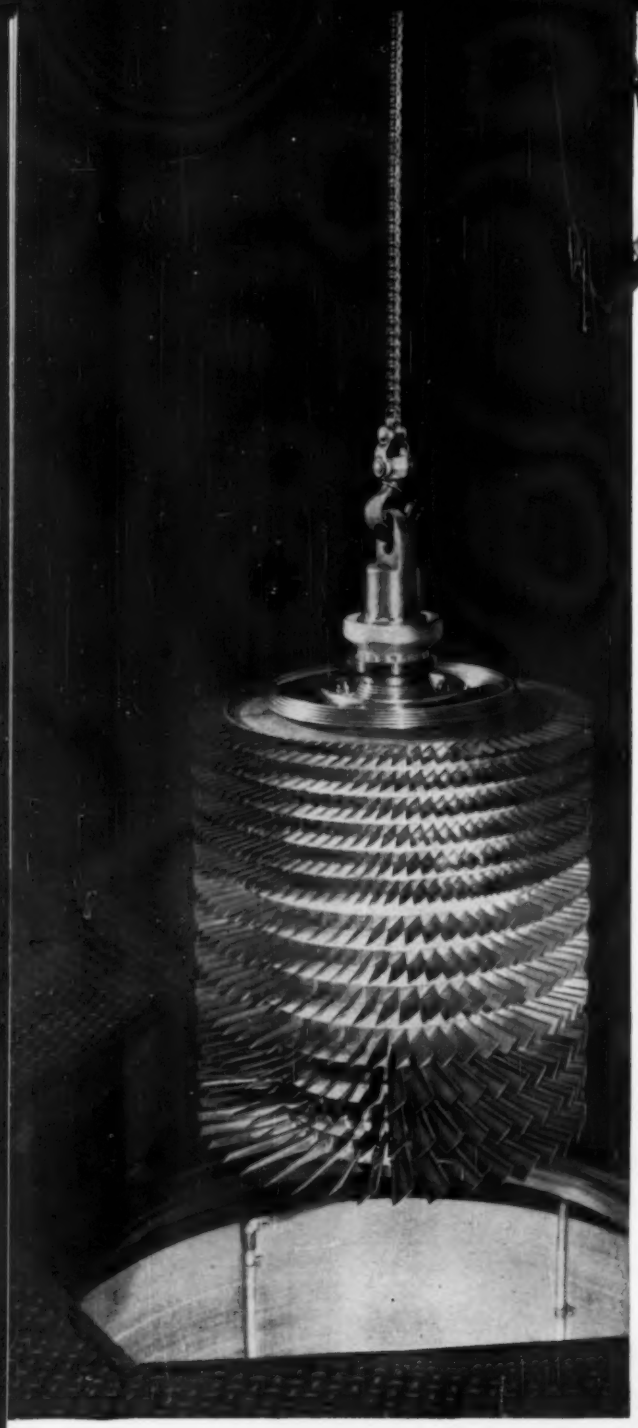

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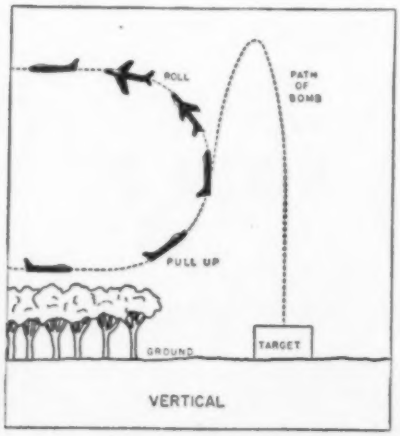
menting on SIGMA free-piston engines imported from France. The free-piston engine is a cross between the older reciprocating engine and the turboshaft. Like the aircraft turboshaft the free-piston engine's output shaft is driven by hot gasses working on a turbine. Likewise the gasses are produced by a self-driven gassifier section. But the free-piston engine's gassifier compressor is reciprocating rather than rotary. Two unattached "free" pistons in a tube shuttle back and forth in the same cylinder, bouncing back from air cushions at the far ends to come at each other compressing and igniting the fuel-air mixture which feeds the output turbine. Big advantage of this arrangement is that less heat is lost and the gasses arriving at the turbine are much cooler than in aircraft turboshaft practice. Although the heavier free-piston engine may never compete with the gas turboshaft in an aircraft, it may prove competition for some planned uses of aircraft-type gas turbines in industry.

Superior Tube Co., Norristown, Pa., expects its small precision drawn zirconium and Zircaloy tubing will be used in increasing quantities as part of nuclear heat exchangers. Because of their low neutron absorption tubes of these materials will be used to carry the fluids which will power the turbines through the "hot" reactor, according to Superior.

Metal & Thermit Corp., N. J., has resumed mining of titanium-bearing ore in Virginia. The firm has opened a $2,500,000 research and distribution center in the Woodbridge-Rahway area of New Jersey.

Low Altitude Bombing System (LABS) provides the automatically programmed maneuver which allows a pilot to escape radar detection by coming in on his target at tree top level; pull up and let go an atom bomb at the correct time; then roll over on his back and escape before it is too late. Minne-



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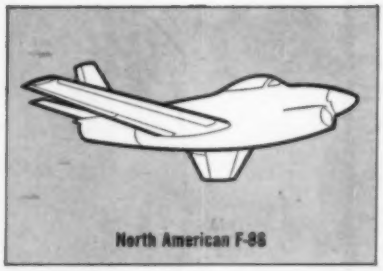
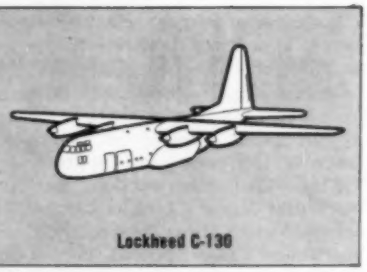
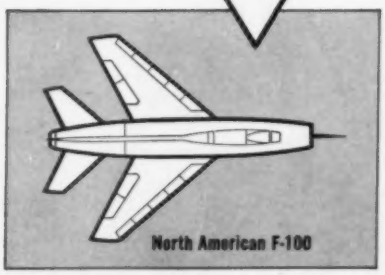
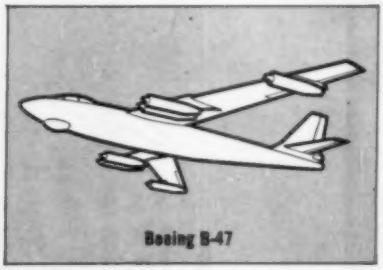
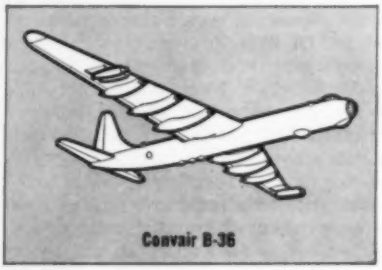
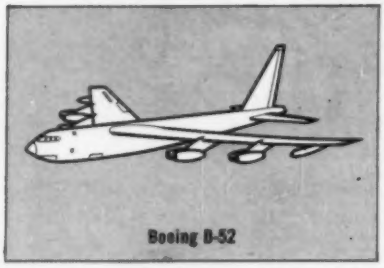

North American F-88

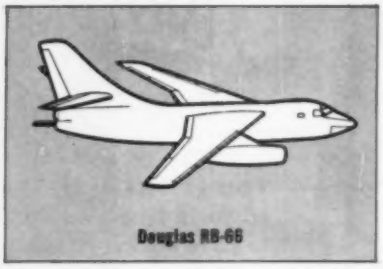

Lockheed C-130

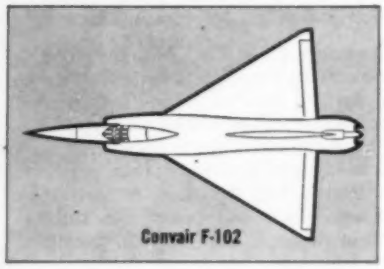

North American F-100

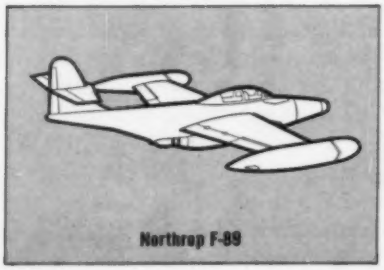

Boeing B-47

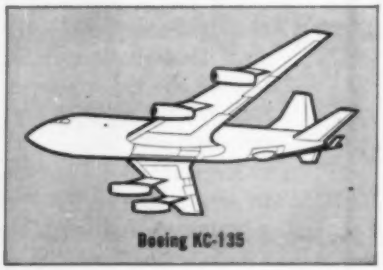

Convair B-36

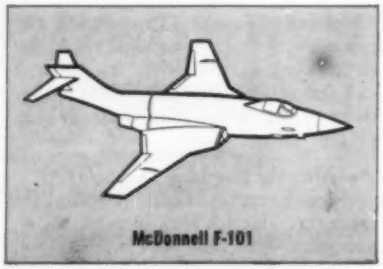

Boeing B-52


Douglas RB-66


Convair F-102


Northrop F-89


Boeing KC-135


McDonnell F-101

These American aircraft all carry ducting components by Solar

LEADING TURBINE-POWERED aircraft use Solar-built ducting in their pneumatic systems. Designers of these planes depend on Solar's unique facilities for complete systems or individual assemblies to meet the most stringent specifications.

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apolis-Honeywell Regulator Co., packager of the guidance and timing system, has been awarded an Air Materiel Command follow-up contract for $2,171,464, plus $472,101 committed for spares and service.

Daley & Sibley, West Haven, Conn., new and used machinery and equipment suppliers and rebuilders, say that progress in aviation is responsible for the quantity of used machinery they are able to offer.

WHAT'S NEW

Publications Received

• *Reinforcement of Silicone Rubber with Carbon Black, PB* 121231—by A. J. DeFrancesco, Connecticut Hard Rubber Co., for Wright Air Development Center—Available through OTS, U. S. Department of Commerce, Washington 25, D. C. $1.00; 33 pp.

The successful reinforcement of silicone rubber with carbon black.

• *Powder Fabrication of Aluminum Alloys, PB* 121138—by J. B. Hess and R. S. Mateer, Kaiser Aluminum and Chemical Corp., for Wright Air Development Center—Available through OTS, U. S. Department of Commerce, Washington 25, D. C. $.75; 26 pp. (Also available on microcard from Photoduplication Service, Library of Congress, Washington 25, D. C. $1.80).

Discussion of preparations of aluminum-base powder alloys containing additions of various intermetallic and refractory compounds not usually alloyable with Al.

• *The Effect of Prior Creep on the Mechanical Properties of Alclad 2024-T3 Aluminum Alloy Sheet, PB* 121250—by C. E. Beck, Wright Air Development Center—Available through OTS, U. S. Department of Commerce, Washington 25, D. C. $1.00; 34 pp.

Results of tensile tests at room temperature and at 500F on aluminum sheet specimens subjected to various amounts of creep deformation.

• *Increasing the Ratio of Modulus of Elasticity to the Density of Titanium Alloys, PB* 121151—by W. H. Graft, D. W. Levinson, and W. Rostoker, Armour Research Foundation, for Wright Air Development Center, U. S. Air Force. Available from OTS, U. S. Department of Commerce, Washington 25, D. C. $2.00; 74 pp.

• *Investigation of a Multiple-Source Schlieren System for Application to a Perforated Wall Wind Tunnel, PB* 111910—by M. Pindzola and G. R. Mozer, Arnold Engineering Develop-

Our engineers are on the ball

Without being teed off . . .

Let's face it. Engineers are people, and people have a habit of blowing off steam once in a while, either rightly or wrongly. Kaman Aircraft considers it quite an achievement that the members of the Engineering staff have worked hard and long and well on many classified projects with very, very few grumbles.

We think it's mostly because our Engineers recognize there's a tremendous job to be done at Kaman Aircraft to keep up our end of the National Defense effort, and they are the people who have been elected to do it. Of course, our engineers are technically qualified men who are willing to work. Their reward is the satisfaction of a job well done, plus commensurate pay and working conditions second to none. Our men don't like to be coddled . . . and aren't.

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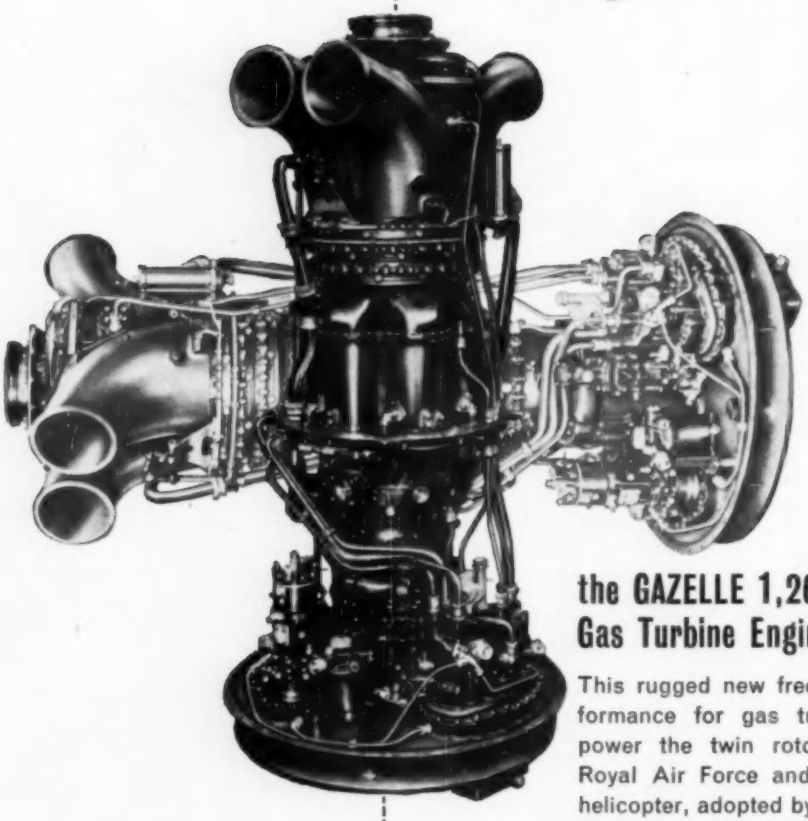

the GAZELLE 1,260-2,000 s.h.p. Gas Turbine Engine

This rugged new free-turbine engine of notable performance for gas turbine-powered helicopters will power the twin rotor Bristol 192, adopted by the Royal Air Force and the Westland S.58 "Wessex" helicopter, adopted by the Royal Navy.

The engine embodies the safe, simple Napier automatic control system.

For ease of installation it can be mounted in any position between the vertical and horizontal.

Helicopters demand tough, reliable engines—the GAZELLE is designed for strenuous duty, long life between overhauls, while its outstanding simplicity means easy maintenance and economical operation.

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ment Center, U. S. Air Force—Available from OTS, U. S. Department of Commerce, Washington 25, D. C. $.75; 25 pp.

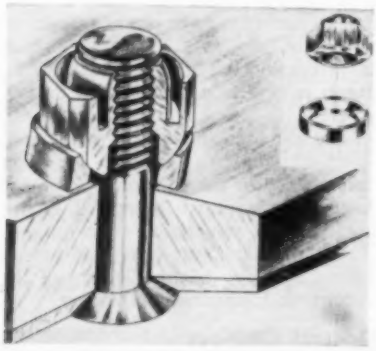
Discussion of results obtained when multiple-source sharp-focusing schlieren system was applied to perforated test walls in transonic wind tunnels.

• *Space Requirements of the Seated Operator, PB* 121053—by W. T. Dempster, University of Michigan, for Wright Air Development Center—Available through OTS, U. S. Department of Commerce, Washington 25, D. C. $3.50; 271 pp.

The geometric, kinematic, and mechanical features of the male physique are studied, with particular reference to the limbs. The detailed report presents material essential for synthesizing realistic manikins, understanding body kinematics of the seated operator (pilot) in his work space (cockpit), and defining work-space dimensions.

• *Arm Strength at Selected Degrees of Elbow Flexion, PB* 111947—by P. A. Hunsicker, University of Michigan, for Wright Air Development Center—Available through OTS, U. S. Department of Commerce, Washington 25, D. C. $1.75; 66 pp.

The Kinematic Muscle Machine, a hand-grip dynamometer developed by WADC, was used to test arm strength of a sampling of young men. The report tabulates strength in relation to degrees of elbow flexion. The machine and modifications necessary during the tests are described.



Hexagon Locknut

New series of self-aligning locknuts (AW April 2, p. 65), which use a hexagon instead of a self-wrenching nut, is being produced by Elastic Stop Nut Corporation of America. Self-aligning feature allows the nut to tilt up to eight degrees from centerline to pick up a bolt fastening non-parallel surfaces. This eliminates much machining and assembly time previously required to fasten non-parallel components. Type LH2935 hexagonal locknuts come in three thread sizes: 10-32, ¼-28, and ⅜-24.

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THE A. W. HAYDON CO. SPECIAL TIME DELAY RELAY **never gives in to severe vibration, shock or sustained acceleration. Positive detent arrangement maintains time setting under all conditions. Large adjusting knob facilitates changing of time setting. Stepless clutch drive minimizes clutch error.**

SPECIFICATIONS

1.* **Voltage Range: 24-29 Volts DC at 68°F.**

2. **Accuracy over Calibrated Range of adjustment:**
   (a) **±0.1 second or ±1% of setting, under condition 1.***
   (b) **±0.15 second or ±2% of setting, over wide temperature range.**

3. **Meet Military Specs. for temperature, altitude, sand and dust, fungus, salt spray, radio filtering.**

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Time delay period can be adjusted in 2/10 second increments over range of 0.2—30 seconds.

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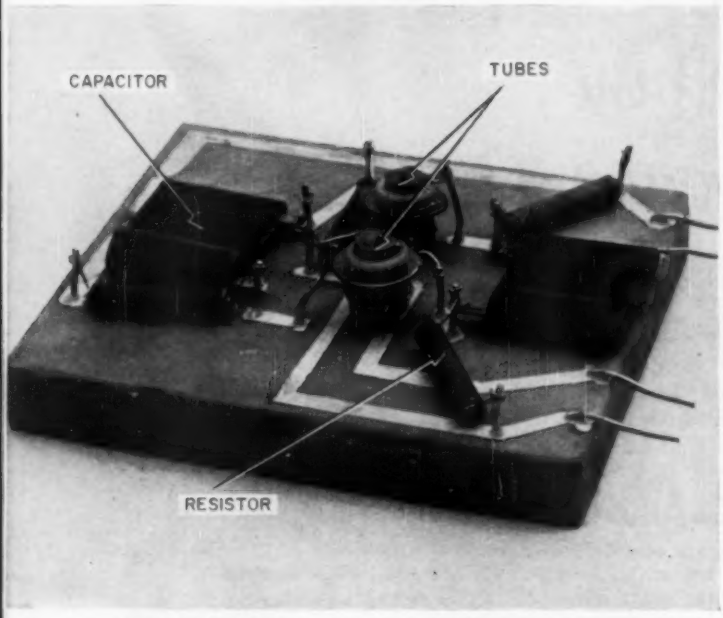
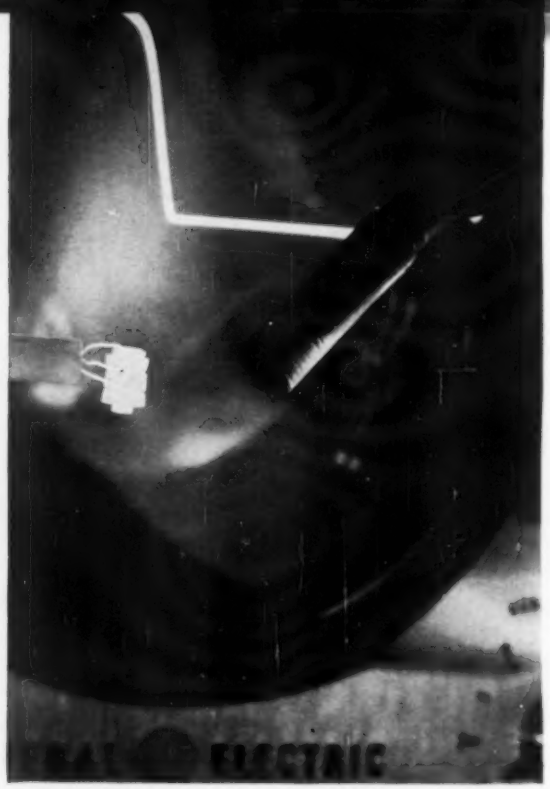
Design and Manufacture of Electro-Mechanical Timing Devices



MULTI-VIBRATOR circuit, using new GE-developed components, has been successfully operated at 700C temperatures.



CERAMIC DIODE tube operates at 800C temperature in gas flame. Oscilloscope trace shows diode characteristics.

GE Reveals 500C Components, Circuits

Remarkable progress in the development of avionic components capable of operating at temperatures above 500 degrees centigrade (932F) will be revealed this week by General Electric.

The need for high temperature components which also are able to withstand nuclear radiation is one of the most challenging problems facing the avionics industry, according to USAF spokesmen.

Lack of such high temperature, radiation-tolerant components already is being felt in the intercontinental ballistic missile, aircraft nuclear propulsion and other advanced weapon system programs.

Here are some of the significant high temperature achievements that GE will reveal:

- **Heater-less ceramic vacuum tubes,** with extremely high transconductance, capable of operating at 600C or higher.
- **Metal-film resistors** capable of operation at 600C.
- **Mica capacitors** which can be used at temperatures up to 800C.
- **Inconel-clad copper wire,** coated with high temperature glass, suitable for 500C operation.
- **Transformers** which have operated successfully at 520C for 500 hr.
- **Servo motor,** using new ceramic stator insulation, silver rotor conductors and nickel-clad wire, capable of operating at 500C.
- **Printed-circuit boards,** using ceramic bases with silver conductors and platinum wire supports, which has been operated at 700C.
- **Multi-vibrator,** a modified Eccles-Jordan circuit, which has operated for 2,000 hours at 500C without failure. When heater-less tubes were used in the multi-vibrator, it was operated at 700C for extended periods.
- **RF detector** and audio amplifier capable of operating at 800C.

Significant Accomplishment

GE emphasizes that its work to date has been exploratory and the new high temperature components, except possibly the ceramic tubes, are not close to production. However, the significance of GE's accomplishment is pointed up by the fact that the electronics industry required 10 years to raise the top operating temperature of its components from 55C to their present 125-150C limits.

Furthermore, this modest but difficult increase did not require the development of radically different materials and techniques such as those needed to meet the new 500C requirement.

Although GE emphasizes its progress in high temperature materials and techniques, the inorganic materials used to meet this requirement are also much less susceptible to radiation damage than presently used materials.

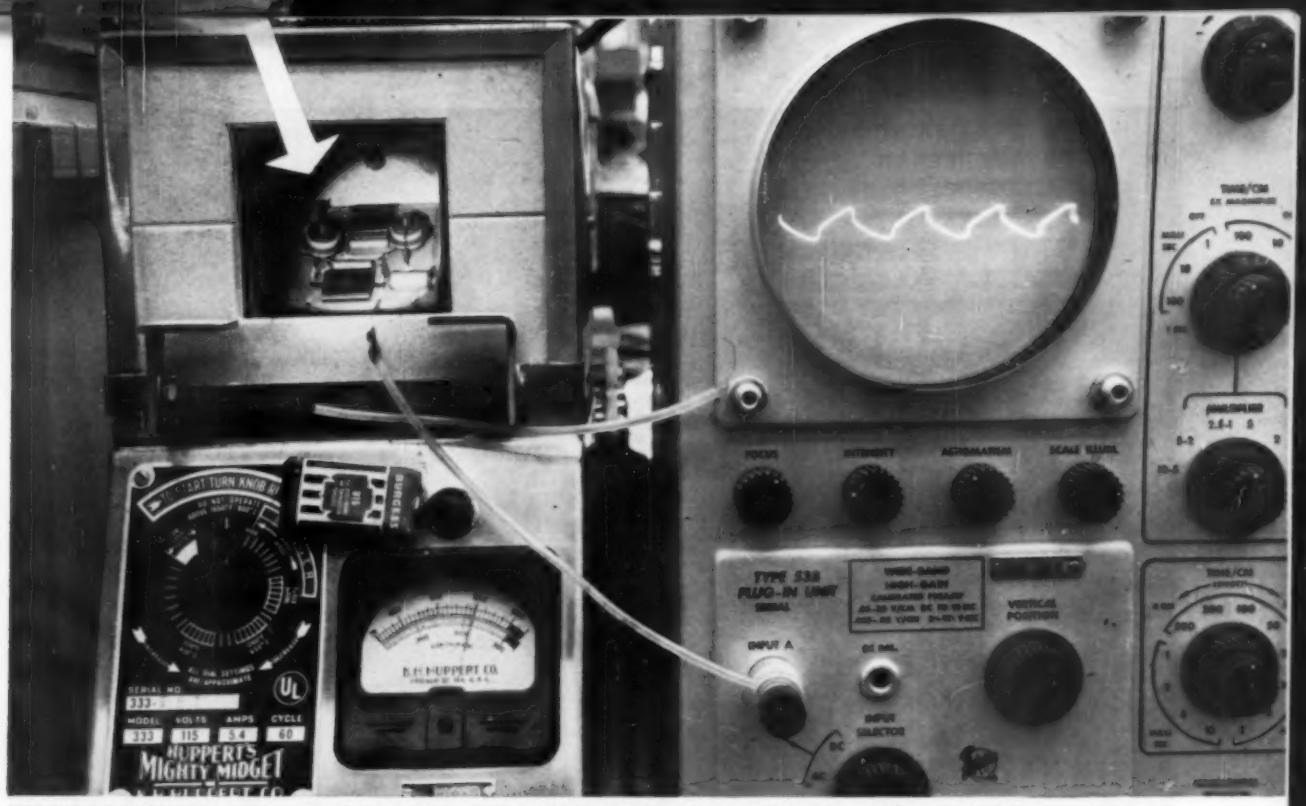
Radiation tests to date on the new experimental high temperature tubes and components have been "very favorable," GE says. It adds that tests which involve both high temperature and radiation in combination are now in progress.

The GE high temperature, radiation-tolerant component program has been spearheaded by the company's Research Laboratory, although other GE groups are making important contributions. These include: Specialty Transformer Dept., Specialty Motor Dept., and the Electronic Components Division.

Radical Changes

Designing avionic equipment to operate in a 500C environment in the presence of nuclear radiation is going to raise both interesting new circuit possibilities and more difficult design problems.

A good example can be found in the high temperature ceramic tubes which GE is developing. (For details, see AVIATION WEEK, Oct. 17, 1955, p. 71.) When these tubes are operated at temperatures of 700C, appreciable cathode emission takes place without any heater power. If the cathode area is increased

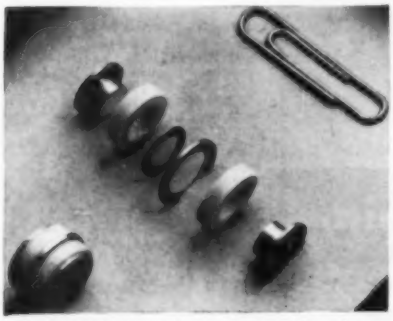


MULTI-VIBRATOR operating in oven (left) at temperature of 700C, exhibits stable waveform on oscilloscope (right).

sufficiently, it is possible to make a tube which requires no heater (or heater power) when operated at 700C.

This has important implications for both the avionic equipment designer and the aircraft/missile designer. Tube heater power is a major load on aircraft/missile electrical power systems —a load that could be eliminated with heater-less tubes. However, this raises other problems because such tubes could not operate properly until their temperature had reached 400 to 500C. (This would be a serious problem for an airplane or missile which had been exposed to arctic cold for an extended period.)

Instead of the present practice of building into an aircraft or missile provisions for cooling avionic equipment, the use of heater-less tubes would require the use of external heating (electrical or other source) while the aircraft/missile is on the ground to keep the tubes at their operating temperatures.



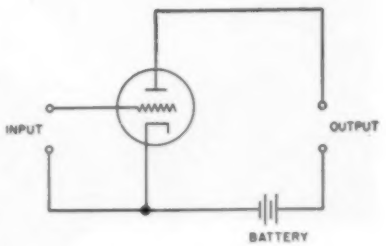
GE heater-less triode ceramic tube shown in exploded view.

This would represent a net gain inasmuch as electrical power can be more efficiently used for heating than for cooling, plus the fact that ground installation has practically an unlimited and economical source of electric power in sharp contrast to electric power generated aboard an aircraft or missile.

Built-in Grid Bias

With tube electrodes operating at extremely high temperatures, it might be expected that the grid would emit electrons as it accumulated barium oxide evaporated off the cathode. However, if the grid is constructed of titanium, the latter absorbs oxygen, leaving only a partial layer of barium on the grid, according to J. E. Beggs of GE's Research Laboratory.

As a result, the ratio of grid to cathode emission is only about 1,000,000 to 1, Beggs says. However, this small grid emission produces a positive contact potential between plate and cathode, resulting in a "built-in" grid bias of about two volts. By taking advantage of this characteristic in tube design, Beggs says it is possible to build a tube which requires no external grid bias, yet would have no appreciable grid current until the grid signal exceeded two volts.



Circuit for using a heaterless triode.

This makes possible extremely simple circuits, such as the one shown above, requiring only a single source of power, Beggs says.

High Transconductance

Heater-less tubes can be designed to have a much higher transconductance (GM) than their conventional counterparts because it is feasible to locate the cathode much closer to the grid.

In a conventional tube with heater, space must be provided between grid and cathode to permit expansion of the hot cathode and to allow for sagging of the grid wires due to the fact that wires become hotter than their supporting frame. In the heater-less tubes, however, all elements except the plate operate at essentially the same temperature so that inter-electrode spacing remains practically constant.

GE's Research Laboratory has constructed heater-less triodes with a transconductance of 6,000 (at one milliamp) when operating at a temperature of

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600C Beggs reports. The use of titanium for all tube electrodes, which exhibits the ability to absorb gasses at high temperatures, also has a beneficial effect on cathode emission life, GE says.

Resistors, Capacitors

Present high temperature resistors are constructed of a hollow ceramic tube whose inside surface is coated with a resistive material. The tube then is sealed under vacuum with two titanium end caps which make electrical connection to the resistive film. Materials developed to date permit resistance values up to several megohms at 600C, GE says.

If future avionic equipment must be designed to operate over wide temperature ranges of −65C to 500C or higher, the temperature coefficient of resistance becomes critically important. The present GE resistive films exhibit a temperature coefficient of about 0.05% per degree over a 600 degree temperature range. Thus a resistor measuring 18,000 ohms at room temperature will exhibit a resistance of 13,000 ohms at 600C.

A figure of merit for dielectric materials is the product of their capacitance and electrical resistance. A high quality mica blocking capacitor, for example, has a figure of merit of several thousand megohm-microfarads. GE's investigations up to now suggest that there are few materials suitable for high temperature capacitors which will have capacitance-resistance products "much better than one megohm-microfarad at 500C," according to W. Grattidge, of the Research Laboratory.

"Users of capacitors at high temperatures will therefore have to take this serious limitation into account when designing circuits," Grattidge said.

Improved Mica

During its investigations, GE discovered that the high temperature properties of certain natural occurring micas could be improved by suitable heat treatment. Most micas crumble when heated to 500-600C as the combined water molecules are released from within the lattice structure. However, GE found that certain domestic micas do not disintegrate and their low-frequency resistivity actually increases with such heat treatment, Grattidge reports.

With such micas, GE has produced capacitors which have been successfully operated at temperatures up to 800C. Using stacked construction, GE has produced capacitors with values ranging from 0.001 to 0.01 MFD, and up to 0.3 MFD, using other construction geometries, Grattidge says.

The multi-vibrator circuit which GE has tested at 700C is built on a ceramic base to which metallic silver conductors have been bonded. Platinum wires imbedded in the ceramic plate at circuit connection points provide mounting supports for the tubes, resistors and capacitors. Components are connected to the supporting wires by brazing or spot welding inasmuch as even 500C is far beyond the melting point of solder.

Design of even a simple transformer becomes a real challenge when it must operate at 500C. For example, conventional magnetic steels used as cores lose their magnetic properties at these elevated temperatures, and the resistance of conventional inorganic insulating materials drops to marginal values, GE says.

Serious Regulation Problems

Even with new materials which GE has used to build its experimental 500C transformer there are problems. For instance the insulation resistance changes by a factor of 1,000,000 to 1 between room temperature and 500C. The excitation requirements of the magnetic core increase by a factor of 200 to 300% and the resistance of the conductors increase by 300%, raising serious regulation problems.

GE says that 500C transformers will be slightly larger and heavier than their conventional counterparts, barring unforeseen technological breakthroughs.

General Electric has financed approximately 50% of its high temperature component development program privately.

The remainder has been financed largely with funds from GE's military programs, including its aircraft nuclear propulsion and intercontinental ballistic missile projects. GE holds a contract from Wright Air Development Center for the specific development of 500C radiation tolerant transformers.

Helicopter TV Post

Helicopter-borne TV system enables shipboard commander to follow amphibious landings. Developed by Philco, under Navy sponsorship, the airborne TV picture is transmitted back to base by 100 watt FM transmitter. High gain antenna is dropped into position under helicopter after it becomes airborne.

Expansions, Changes In Avionics Industry

A new Technical Military Planning Operation, with responsibility for preliminary planning of future complex weapon systems, is being organized by General Electric's Defense Electronics Division. The new group, called TEMPO for short, will be headed by Dr. Richard C. Raymond, former head of Rand Corporation's Electronics Dept.

Other recently announced changes, expansions and mergers in the avionics industry include:

• **The Telecomputing Corp.,** Los Angeles, has acquired Brubaker Electronics, Inc., Culver City, Calif., manufacturer of components and systems. The new acquisition will be operated as a wholly owned subsidiary under its founder, George Brubaker.

• **Potter & Brumfield, Inc.,** Princeton, Ind., maker of relays, will expand its production facilities with a new 125,000 sq. ft. addition.

• **Buroughs Corp.** has organized a new Electronic Tube Division at Plainfield, N. J., to be housed in the plant of Haydu Brothers of New Jersey, Inc., formerly a Burroughs subsidiary. New division, headed by Saul Kuchinsky, will manufacture special vacuum tubes including beam switching and numerical indicating devices.

• **General Electric's Advanced Electronics Center, Ithaca, N. Y.** becomes part of GE's Light Military Electronic Equipment Dept. (LMEED) in an

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Lightweight traveling-wave tube weighs only 2¾ lb., one fifth the weight of its conventional counterpart, shown below. New Type TW 956 tube, developed by Sylvania, uses permanent magnets for focusing, eliminating previous solenoid which consumed 300 watts, required heavy power supply and cooling provisions. Tube is operationally similar to Type 6559, provides 30 db. gain, 2 watts output over frequency range of 2 to 4 kmc.

organizational shift. The laboratory, which remains at Ithaca, will be headed by O. H. Winn, succeeding Walter Hausz, now on assignment with a special study group for the Secretary of Defense.

• **Texas Instruments, Inc.,** Dallas, has acquired the Wm. I. Mann Co., Monrovia, Calif., in a stock exchange arrangement. The new addition operates in the fields of optics and infrared.

• **Huggins Laboratories, Inc.,** Menlo Park, Calif., maker of traveling-wave tubes, is completing a plant addition which will double its space, giving a total of 16,000 sq. ft.

• **Thomas A. Edison, Inc.,** West Orange, N. J. has acquired the Rosеland, N. J. plant, equipment and inventory of Infra Electronic Corp. The new addition makes servo motors and synchros. Almost all of Infra's technical personnel are expected to remain, Edison officials say. William H. Balentine will be general manager of the Roseland plant.

New Vibration Testing System Developed

A new vibration testing system known as the Hydrashaker, using electronically actuated hydraulic power amplification, will be produced and marketed by Wyle Mfg. Corp., El Segundo, Calif., under an exclusive license from Northrop Aircraft, Inc. The principle of the system has been tested in a prototype constructed by Northrop for vibration evaluation tests of its SM-62 Snark missile.

In the Hydrashaker version designed by Wyle for testing missile and aircraft structures and components, accelerations will be provided up to 100G with 0.2 in. total displacement and 20,000 lb. block force. Frequency range is expected to span 5 cps. to 2,000 cps. Only 15% of available force will be expended to drive the equipment's 30-lb. moving assembly to 100G, according to Wyle.

A fatigue test system employing the power principle is now under research and development at Wyle.

FILTER CENTER

► **New Reliable Tacan**—Collins Radio will soon deliver about a dozen of its ARN-21 (XN-10) Tacan sets to Navy and USAF for evaluation. Design goal for the XN-10 was to improve reliability. Collins flight tests to date show very few failures, none of them repetitive, as well as improved performance with no false lock-on or continuous search problems which plagued early Tacan models.

► **New Type Transistors**—Two new germanium transistor types, one for high-speed switching and the other with an alpha cut-off frequency of 600 mc. have been disclosed by Philco. Both are made by newly developed techniques:

• **Micro-Alloy Transistor** (MAT) is said to be "at least 10 times faster than the fastest vacuum tube in electronic computers." It has a doped layer only "a few millionths of an inch thick," Philco says, made by a new micro-alloying process.

• **Surface-Barrier Diffused Transistor** (SBDT), for use in the 20 to 200 mc. range, is made by surface diffusion technique in which germanium pellet is exposed to desired impurity in high temperature gaseous form which penetrates germanium surface by diffusion.

► **High Temperature Tubes**—Sylvania Electric Co. has completed pilot line at its Emporium, Pa. plant for production of hard-glass tubes capable of operating at 300 C. New pilot line will enable Sylvania to cut tube price to $7.50, from previous $30 figure when tubes were built by laboratory methods. USAF's Air Materiel Command sponsored the new high temperature tube manufacturing facilities.

► **Handy Handbook**—Allied Radio Corp. has prepared a 64-page "Electronics Data Handbook," containing often-

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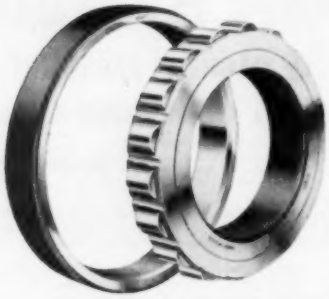

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used formulas and data. Handbook includes RETMA and Military specs for resistors and capacitors, data on attenuator networks, trigonometric and logarithms tables. Handbook is identified as Stock No. 37 K 398. Price is 35 cents. Address: 100 No. Western Ave., Chicago 80, Ill.

▶ **Instrumentation Conference**—Second Annual IRE Instrumentation Conference will be held at the Atlanta (Ga.) Biltmore Hotel, Dec. 5-7. Prospective authors of papers on solid-state devices and electronic components, guided missile range and earth satellite instrumentation, or laboratory and test equipment, should submit 200-word abstracts to M. David Prince, Program Chairman, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Ga.

▶ **New RADC Facility**—Multi-million dollar facility for testing super high power radar system components will be constructed next spring by Rome Air Development Center. Facility will be available to Air Force engineers and contractors developing radar transmitters, tubes, duplexers and waveguides.

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Components & Devices

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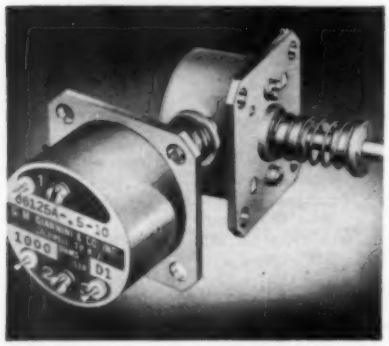

• **Regulated d.c. power supply,** for airborne use, operates from 115 v., 400 cps. single phase input, provides up to 1,000 ma. d.c. output at voltages from 100 to 600 v. Magnetic amplifiers provide regulation of 0.1%, ripple 0.05%. Units reportedly meet MIL-E-5272A

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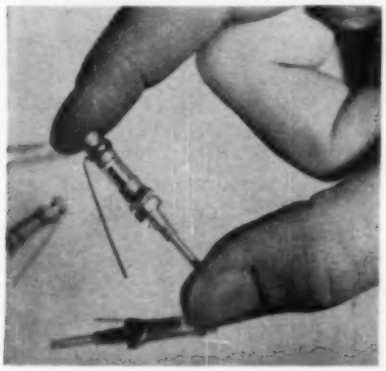

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• **Transistorized d.c. to d.c. converter,** delivers 50 watts at d.c. voltage of 20 to 20,000 v. operating from 28 v.d.c.

input. Unit weighs only 2 lb. Universal Atomics Corp., 19 East 48th St., New York 17, N. Y.

• **Power transistor,** P-N-P germanium Type 2N235A, for audio applications, can dissipate 5 watts at 75C mounting base temperature. Collector current rating is 2 amps at 75C. Power gain is 30-40 db. Transistor operates from 12 volts.

Semiconductor Products, Red Bank Div., Bendix Aviation Corp., 201 Westwood Ave., Long Branch, N. J.

• **Transistor,** P-N-P germanium diffused alloy junction Type 2N237, is rated 150 mw. collector dissipation at 55C, and intended for low-noise audio applications.

Marvelco Electronic Div., National Aircraft Corp., 3411 Tulare Ave., Burbank, Calif.

Microwave Devices

• **Ferrite isolator,** Model 152-2A, for use in the 8 to 12 kmc. band, will handle 100 kw., give 25 db. isolation with insertion loss of less than 0.25 db. over a 200 to 300 mc. bandwith. Kearfott Co., Inc., Western Div., 253 No. Vinedo Ave., Pasadena, Calif.

• **Miniature backward wave oscillator,** Model VA-161, operates over 8.5 to 9.6 kmc. band, requires less than 300 volts, weighs under 5 lb. Unit employs metal-ceramic construction, enabling it to withstand airborne environment. Manufacturer says additional models for fre-

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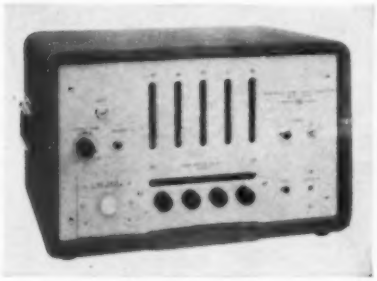
WALTHAM 54, MASSACHUSETTS

quencies up to 40 kmc. are under development.

Varian Associates, 611 Hansen Way, Palo Alto, Calif.

Test Equipment

• **Computing digital indicator,** Model DY-2500, permits direct read-out of speed, rpm., pressure, thickness and other quantities without subsequent conversion calculations. Device contains a variable gate that functions as



multiplier to provide direct readings. Gate time can be set by plug-in panel or is manually adjustable for readings from 0.0001 to 0.9999 in 0.0001 second increments.

Dynac, Inc., 395 Page Mill Road, Palo Alto, Calif.

• **Micro-microammeter,** Model 410, measures currents of 1 x 10^{-3} to 3 x 10^{-13} amp. over 10 decades on 20 ranges. Accuracy is 3% or better, zero drift is less than 2% full scale after five minute warm-up, with less than 2% in any subsequent 24-hour period. Keithley Instruments, Inc., 12415 Euclid Ave., Cleveland 6, Ohio.

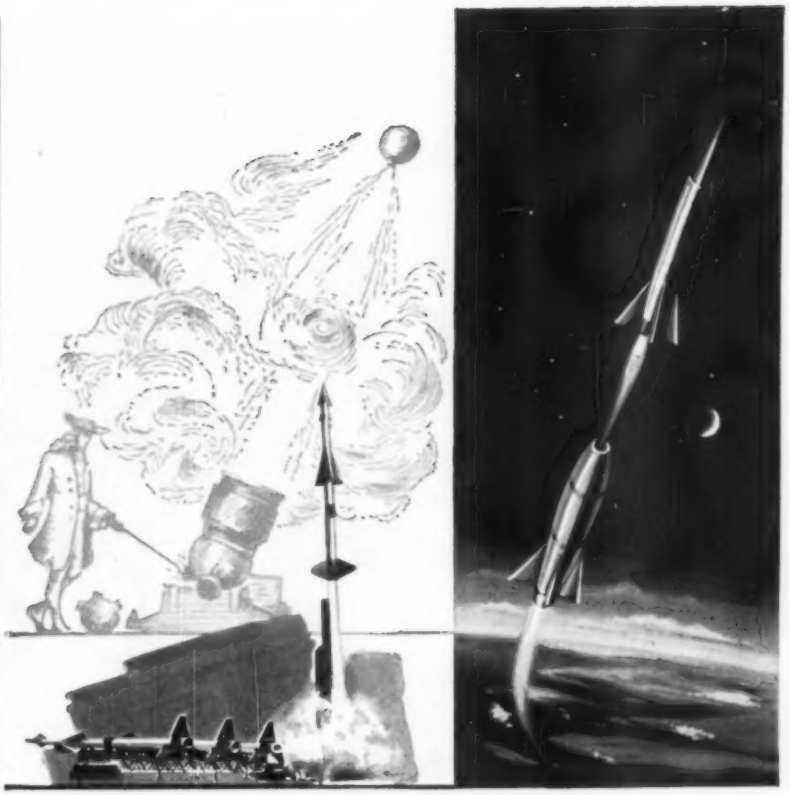
• **Portable transistor tester,** called Transistometer No. 101, tests both P-N-P and N-P-N low power junction transistors, permitting small signal Beta measurements to 250.

Simple calibration requires no "stand-

ard" transistor, provides 5% accuracy.

Device also measures collector cut-off current, weighs 6 lb., is available in kit form for $67.50 postpaid.

Durson Co., 10416 National Blvd., Los Angeles 34, Calif.



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J. L. Hobel, Industrial Relations Manager, Rohr Aircraft Corporation, Chula Vista, California, Dept. 29

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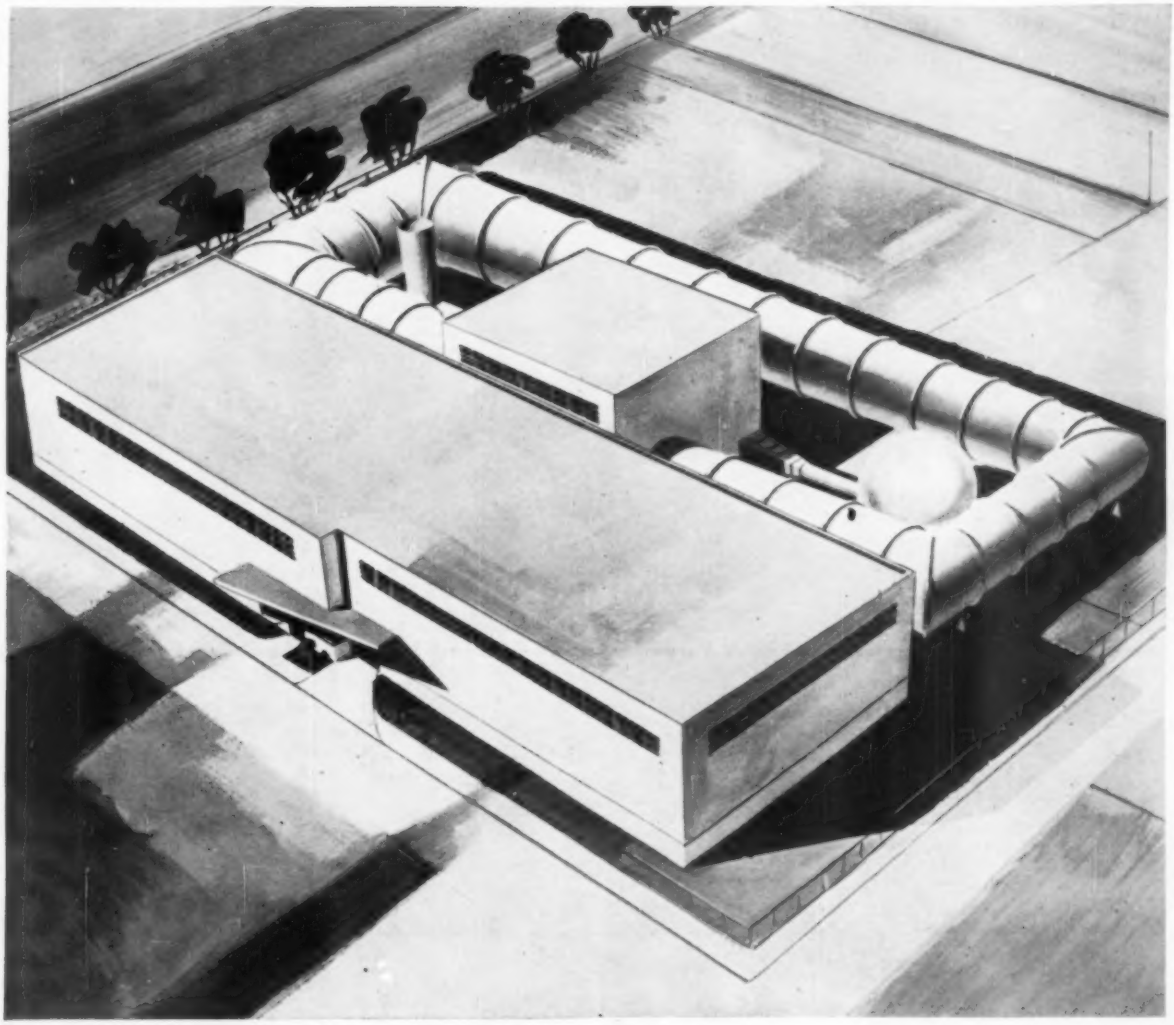

This wind tunnel will permit studies of aircraft flight reactions up to Mach 4.

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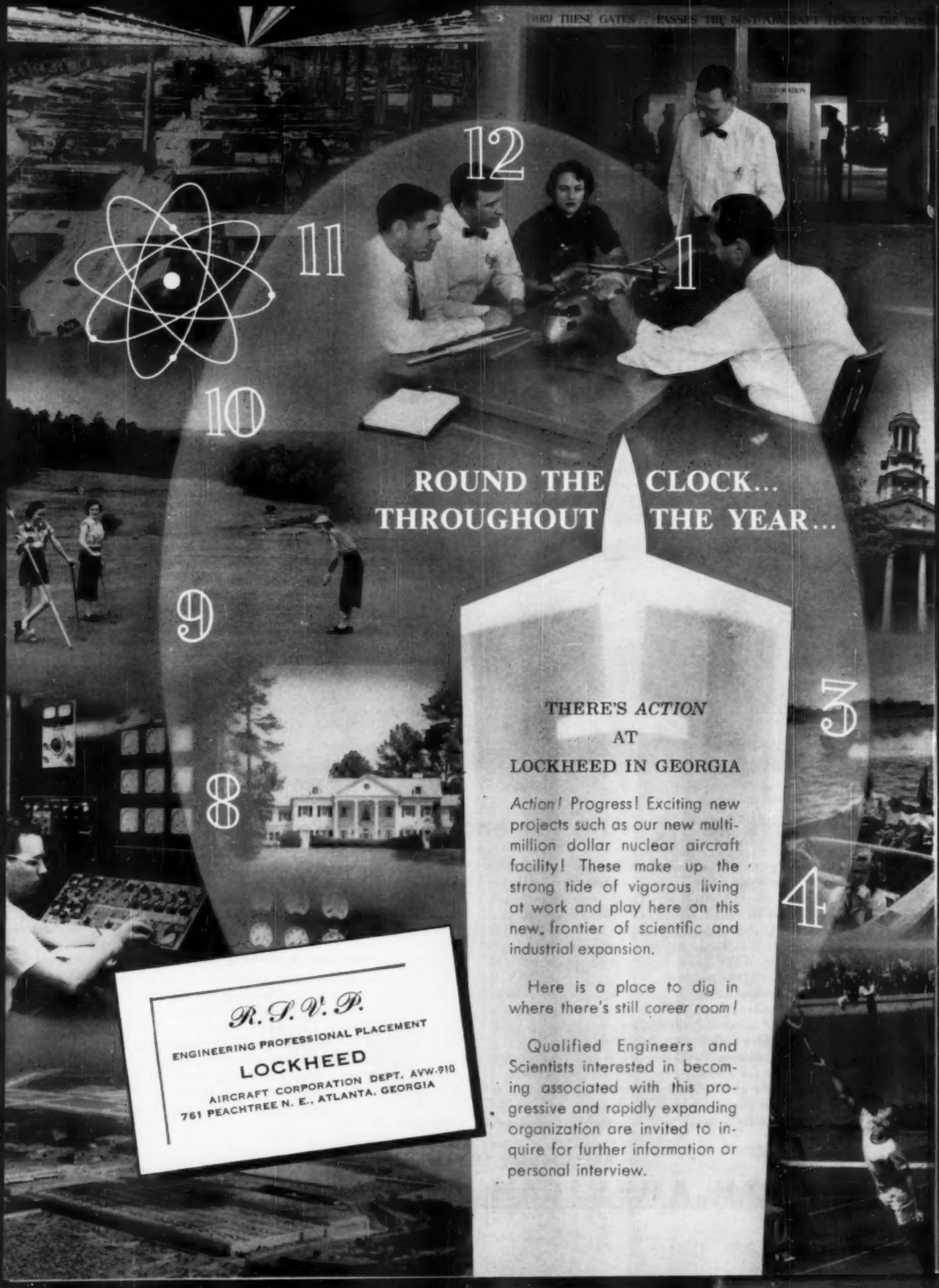
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Business Fliers Form Corporation to Finance Their Air Operations

By Bernie Lang

Burbank, Calif.—Eighty-five Southern Californians have found a way to take advantage of private planes for business or pleasure without having to own one, or at least not much more than one-tenth of one.

They are the Sky Roamers, a nonprofit corporation organized in the belief that many businessmen interested in flying, but unable to justify outright purchase of a plane, could benefit through cooperative airplane ownership.

Starting out in 1946 with 10 members and one training aircraft, Sky Roamers is one of the few clubs that survived the lean years after World War II, when business flying experienced a nationwide slump.

It required a great deal of selling at best to keep the club active. In the last four or five years the club has been selling itself. Membership has risen to 85 and the club now operates two Cessna 170s, five 172s and two 180s from headquarters at the Lockheed Air Terminal. It has an annual budget of $65,000, J. H. Brown, secretary-treasurer and charter member of Sky Roamers, said.

Interest within the organization in twin-engine planes has become so popular the club believes it will be necessary to add at least three of the larger executive airplanes some time after the first of the year. Favored is the Piper Apache, on the ground its initial cost is the minimum in the twin engine class.

Safer, Less Fatigue

Members agree popularity of the Sky Roamers is a natural outgrowth of business decentralization. Areas not frequently served by the airlines or difficult to reach by car are easily accessible when you can fly a plane. Time savings, reduction of fatigue and strain, greater safety and economy than driving a car, are the usual reasons businessmen give for joining the Sky Roamers. All admit an interest in flying for enjoyment.

To qualify for membership, applicants must be responsible, financially able to meet the obligations of the club and possess or be able to procure all licenses, certificates or permits required by the government to operate an airplane. Each member becomes a shareholder with a negotiable share of stock based on four classes of membership:

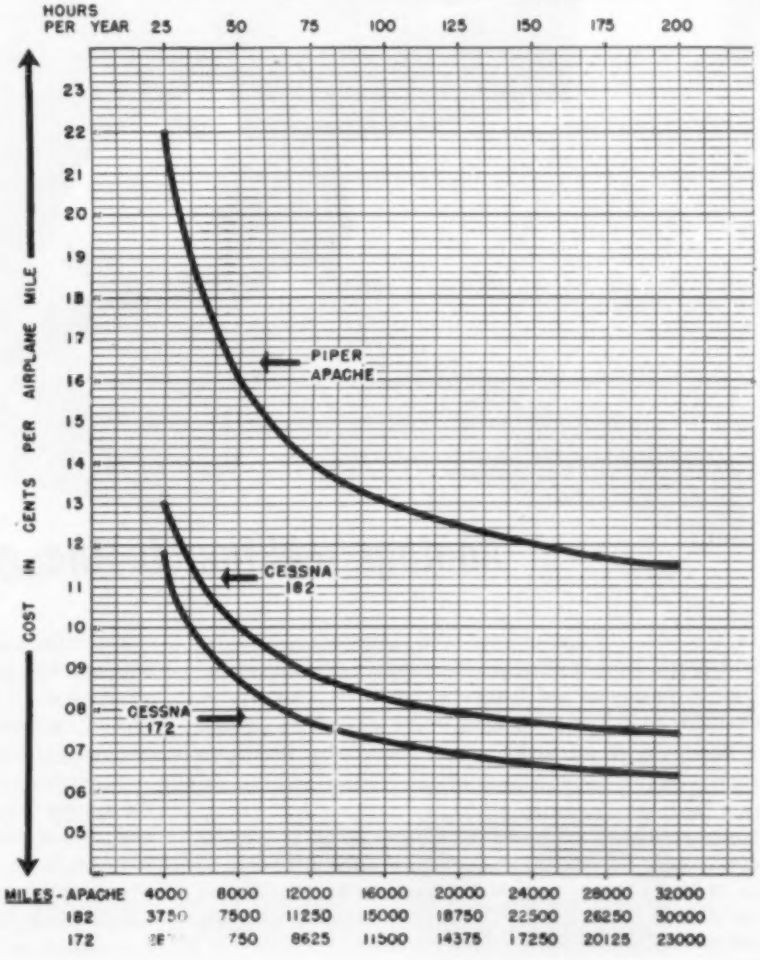
- **Class I.** Valued at $450, it is a primary training membership. Heavy traffic at the Burbank airport discourages intensive primary training and the club has been forced to turn away approximately 50 prospects in the past few months. Sky Roamers now are planning for branch facilities at less congested nearby airports to handle this training.
- **Class II.** Valued at $650, this classification entitles members to fly aircraft of the 170/172 type.
- **Class III.** Valued at $1,000, members are entitled to fly 170/172 and 180/182 type aircraft.
- **Class IV.** Non-active pending acquisition of twin engine airplanes, class IV membership will be valued at $3,500 and entitle holders to operate light twin engine equipment and all aircraft types covered by classes I, II and III.

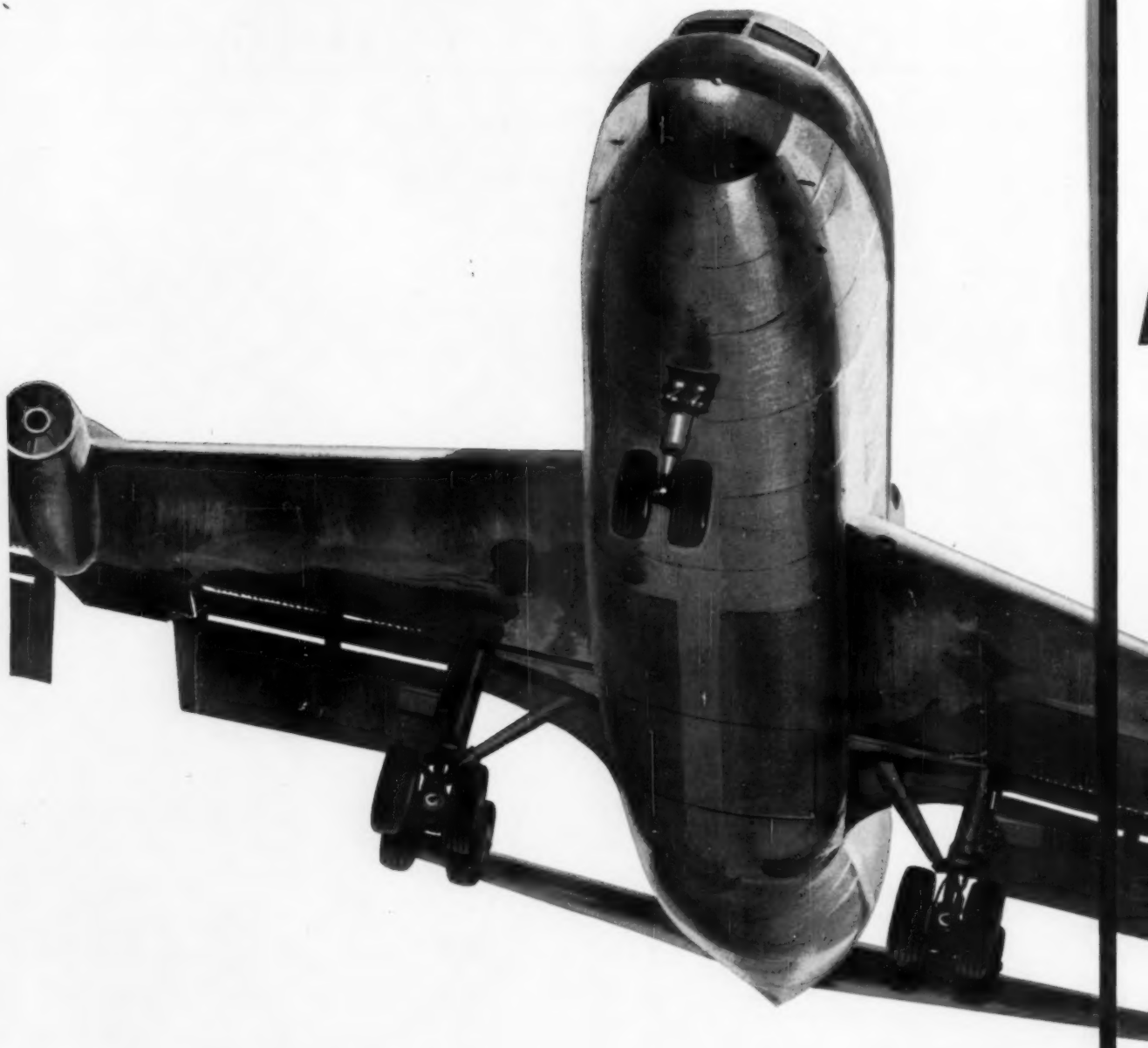
A breakdown of dues and flying rates, covering costs of operating the club, shows that to fly a Cessna 170 the rate is $6.50 an hour, dues $10 monthly; Cessna 172, rate $6.50, dues $15; Cessna 180/182, rate $10, dues $20.

If a class II member flies a 172 for a yearly total of 36 hours (minimum time club members should fly, it would cost him a little more than $400 to travel 4,300 miles or 10 cents a mile. This, of course, is reduced as mileage increases to where the average Sky Roamer figures it costs him about 6¼ cents a mile. Time saved is even more impressive—as much as 75% in some cases.

"Flexibility, safety and economy

SKY ROAMERS — COST ANALYSIS





Another addition to the growing list of future

In its new 707 Stratoliner and Intercontinental jet transports, Boeing offers an outstanding example of the high performance and luxury and comfort that will be available to airline passengers in the up-coming jet age.

Bendix is proud to have been chosen by Boeing to supply its PB-20 automatic flight control systems for this "aircraft of tomorrow".*

***Initial deliveries of PB-20-equipped 707s will be to American Airlines and Trans World Airlines. Previous decisions in favor of the PB-20 system were for Lockheed Turboprop Electras, Lockheed 1649A Constellations, Douglas C-133A USAF Turboprop transports, and two of Canada's latest military aircraft.**

The PB-20 is the culmination of a ten-year Bendix development program pinpointed at the design and production of a simplified automatic flight control system that would satisfy completely the vastly more complex needs of the new age of flight.

Application of transistors and magnetic amplifiers in the system has brought about the greater sureness that will be so essential tomorrow. Another important advance in the PB-20 is its continuous self-adjustment over a wide range of airspeeds . . . thus making possible safe, smooth control whether the aircraft is cruising at upwards of ten miles a minute or landing at 100 mph.

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Ability to capture a radio navigation beam from any approach angle; building-block, or modular, system design for easier maintenance; miniaturization to save space and weight; and super-sensitive air data sensor (measures to a sensitivity of ± one foot) able to maintain incredibly close control over any cruise profile—these are other features that make the PB-20 the most advanced, yet the simplest, most sensitive, most flexible automatic flight control system yet developed and in production today.

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Norwalk, Connecticut

FLIGHT EXAMINER and instructor H. T. Childers and Ed Smith, new Sky Roamer member, go through pre-flight inspection of club's Cessna 172 prior to Smith's check-out flight (left). J. H. Brown, secretary-treasurer, about to takeoff in Cessna 180 (center). Harold Hopkin, club maintenance supervisor, at Cessna in Wichita picking up fifth 172 that Sky Roamers purchased this year.

make membership in the Sky Roamers more attractive than owning my own plane," explains Jerry L. Pettis, former United Air Lines pilot and assistant to the president.

"Capital investment," Pettis said, "is at least one-tenth less and operating costs as much as 50% less than private ownership. Availability of the club's nine airplanes offers a very flexible arrangement. When one ship is down for inspection, there are always others available.

"In the many years I have been with the Sky Roamers, I've never had to sit out a roster. There may have been a time or two I've settled for a 170 when I wanted a 180, but I usually plan a schedule a month in advance and find very little difficulty getting a plane when needed."

One member traveling the western half of the country who usually made one call on his customers every three or four months when using a car said having the advantages of the Sky Roamers club afforded him an additional personal contact with his widely scattered customers.

Wolfgang Reitherman of Walt Disney Productions values the time saving factor. "When we release a picture we like to get various audience reactions immediately," he said. "Having a Sky Roamer plane available often means making a matinee in San Francisco, another in Sacramento and an evening show in Salinas, all in one trip," he said.

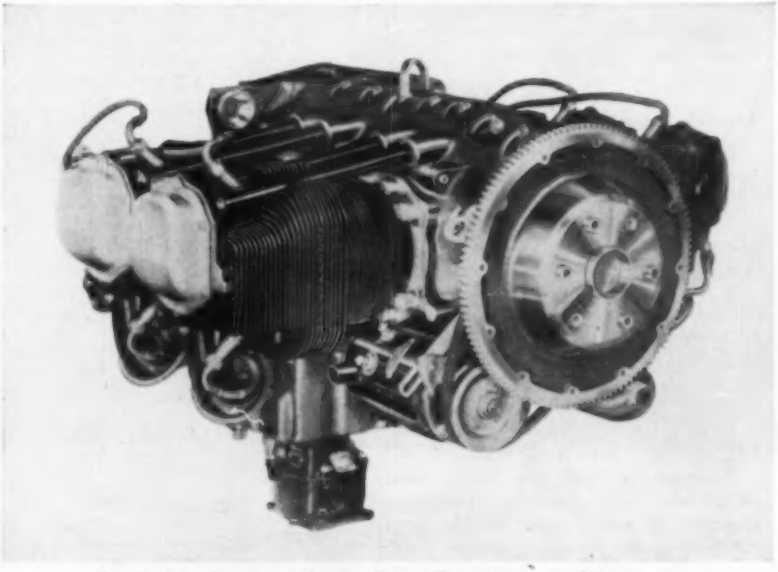
Share Plane

Another member cited the "share your plane" advantage. Normally he flies about 100 hours a year which costs him about $794. But on long trips, friends or business associates share expenses so that it averages out to not much more than $300 a year.

Building contractor E. C. Vettel considers it a means of advertising his business. "More people will know you through flying," he said. "On one construction job in Palm Springs recently, I made over 27 round trips between Los Angeles and Palm Springs in 90 days. Using a plane in business still is novel enough to attract attention."

Another member praised the safety record of the club. All airplanes are equipped with up-to-date instruments, aids to navigation, communications equipment and safety devices. The ships are in constant use and always under scrutiny of the pilot, a safety advantage over a plane that may sit on the ground a couple of weeks or months in between trips.

The club tries to maintain a balanced membership of business and recreational flyers for maximum utilization of the airplanes. "We keep them flying over the weekends as well as during the week," Brown says. Utilization of nine planes during the past month was in excess of 675 hr. Club records show Sky Roamers have accumulated a total of 28,000 hr. of flying time, or as one Sky Roamer put it, "as a group that means we've flown around the world 140 times."



Latest Lycoming for Business Planes

New Lycoming 0360 four-cylinder opposed aircooled engine, rated at 180 hp. at 2,700 rpm., weighs 282 lb. including starter and generator. A development of the 150-hp. 0320, the 0360 powers the Beech Badger and prototype Piper Comanche business planes. The engine measures 24.68 in. high x 33.37 in. wide x 29.56 in. long, features rotator-type salt-cooled valves, all-chrome piston rings and nitrided crankshaft. It has been certificated by Civil Aeronautics Administration.

FIRST PROTOTYPE of Saeta after modifications. Experience gained from HA-200 is to be applied to probable later fighter project.

Hispano HA-200 Saeta Specifications	
Span	34.17 ft.
Length	29.09 ft.
Height	9.41 ft.
Wing area	187.2 sq. ft.
Aspect ratio	6.22
Max. speed (sea level)	397.4 mph.
Max. speed (19,680 ft.)	409.8 mph.
Max. dive speed	565 mph.
Landing speed	77.6 mph.
Takeoff distance (over 50 ft.)	1,836.8 ft.
Landing distance (over 50 ft.)	2,361 ft.
Gross weight (gunnery)*	5,830 lb.
Empty weight (gunnery)*	3,608 lb.
Gross weight (bombing)*	6,270 lb.
Gross weight (gunnery)**	6,710 lb.
Gross weight (bombing)**	7,150 lb.

* Minus tip tanks. ** With tip tanks.

Simple Design Marks Spain's First Jet Built By Willy Messerschmitt

Madrid—Simple, straightforward design marks construction of Spain's first jet airplane, the Hispano HA-200 R1 Saeta (Arrow), a light twin-jet trainer developed by a German team of designers headed by Willy Messerschmitt.

It is expected that experience gained from the HA-200 will be applied to a later project, the HA-300 light fighter, now in the design study stage.

The Spanish government has placed a contract for production tooling of the HA-200 trainer. Prof. Messerschmitt also has retained license rights to build the plane in Germany and the German designation of Me-200 has been given the jet trainer.

Twin-Jet Layout

Design feature of the HA-200 tandem two-seater is the side-by-side nose placement of its two French-built Turbomeca Marbore IIA turbojets of approximately 900 lb. thrust each behind an oval bifurcated intake. Engines are independently mounted, have their exhausts existing on either side of the cockpits and mounted. Exhaust gases exit through individual tailpipes on either side of the fuselage below the wings.

Pipes protruded on the prototype, but since have been made flush.

Fuselage is built in three main assemblies: nose section containing engines, oil tanks, nose landing gear, machine guns; a center section comprising the cockpits, structure for wing attachment and the main fuel tanks, and the rear portion carrying the tail.

Fuel tank arrangement comprises two main tanks under the cockpits and an additional tank in the leading edge of each wing, all cells being interconnected. There is a special fuel tank in the forward fuselage section for feeding the engines during brief intervals of inverted flight. Fuel boost pumps are in each main fuselage tank. The HA-200 has provision for auxiliary external tanks at the wingtips.

Wing Markup

Wings are trapezoidal in planform, slightly swept. Construction follows Messerschmitt past practice, being built around "T" spars, the main spar and leading edge forming a torsion box. Heavy skin is employed to maintain laminar flow. Fowler-type flaps of 8.03 ft. span are fitted. Ailerons are 6.1 ft. long. Wing airfoil section is derived from the NACA 63 family with a relative thickness of 15% at the wing root to 13% thickness at the tips. Wing incidence is four degrees at the roots, decreasing progressively to one degree at the tips. Dihedral is 3 deg. 50 min.

Tail section is of cruciform layout, comprising a trapezoidal vertical fin built of twin spars made from folded dural plates. Variable incidence tailplane is controlled by an electric-hydraulic system.

Landing gear is Hispano Aviacion's own design and is composed of single legs with hydraulic shock absorbers. Main legs are fitted to the rear face of the main spar. Wheels are fitted with low-pressure tires.

Radio comprises one VHF set and a radio-compass, both having controls and indicators in each cockpit. Standard blind flight instrument panels are fitted. Pressurization equipment will be installed in production models; the protoype is minus this equipment.

To meet Spanish Air Force specifications, the HA-200 will be able to mount two 12.7 mm. machine guns located above the jet engines, four Oerlikon rocket launchers for 24-lb. missiles and four bomb racks for carrying 110-pounders. A reflector gunsight will be mounted in front cockpit.

As a result of initial flights this spring, the following changes were worked into the first prototype: Wing dihedral was increased, dorsal fin area was enlarged and the vertical fin was made taller. Rudder chord was decreased. A second prototype is scheduled to start flight tests this year.

FRONTAL VIEW of Saeta with new dihedral. Note side-by-side nose placement for two French-built Turbomeca Marbore HA turbojets of 900 lb. thrust each.

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Pours Out Its Power Through SPECO Transmissions

This mammoth turbine-powered helicopter of "1001" uses is the Vertol YH-16A. The production version will be able to carry up to 12 tons and can whirl into action without warm-up to achieve an air speed of over 150 mph. Transferring the output of its turbine into a smooth, steady flow of propelling power is the job of the forward and aft transmissions produced by SPECO, the Steel Products Engineering Division of Kelsey-Hayes.

The manufacture and assembly of gears and gear assemblies which insure dependable, maintenance-free performance such as required in the Vertol YH-16A is a Speco specialty, one of 40 years standing in service to the aviation industry.

Rotor transmission from YH-16. The transmissions, clutch assemblies, synchronizing shafts and drive shaftings are produced by Kelsey-Hayes in accordance with Vertol's design specifications.

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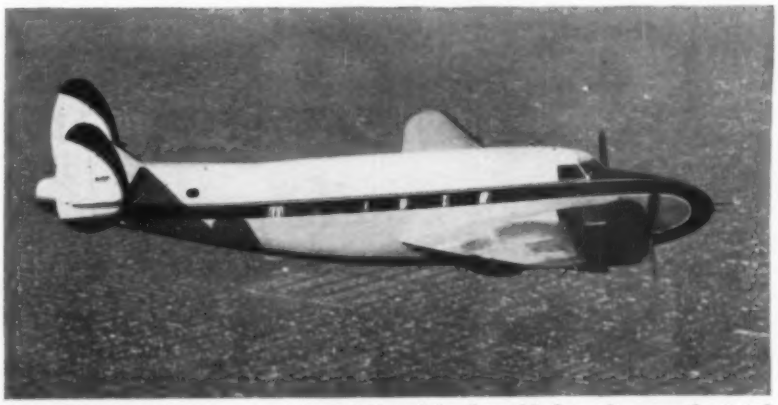
Learstar Mk. 2 Improves Over Mk. 1

By Richard Sweeney

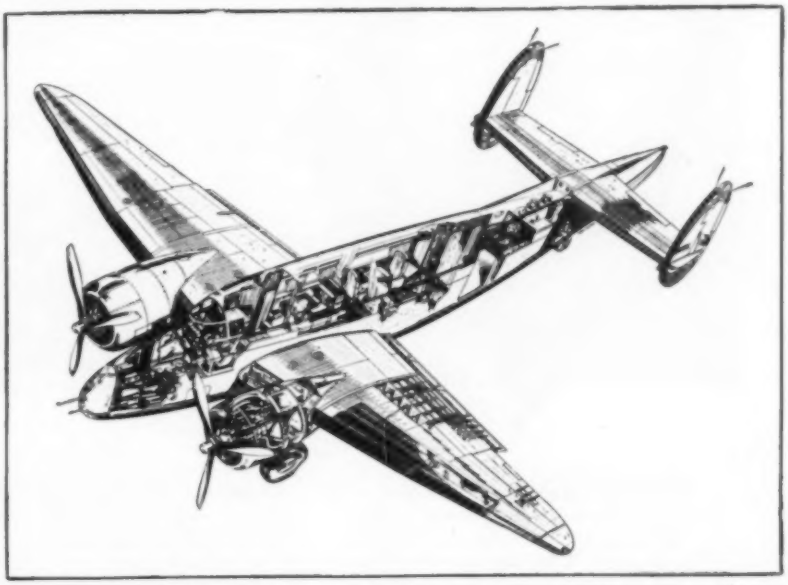
Santa Monica, Calif.—Prototype Learstar Mk. 2 business transport, a Lockheed Lodestar conversion providing major performance gains without disturbing the customer's original interior, instrumentation and equipment, has been delivered to Plymouth Oil Co., Sinton, Tex. Plymouth's new Learstar Mk. 2 incorporates the majority of Learstar Mk. 1 aerodynamic improvements at approximately 60% of the cost of conversion to the Mk. 1 configuration. Conversion of a Lodestar to Learstar Mk. 2 costs approximately $175,000. The customer received his airplane from Lear Aircraft Engineering Division shops near here 90 days after turning it in for rework. Plymouth's business transport cruises at over 290 mph. TAS at 10,000 ft. using 840 hp./engine, and over 270 mph. TAS at the same altitude drawing 700 hp./engine.

Basis of the Mk. 2 conversion are changes in the outboard wing panels, power packages, nose, empennage, and intermarriage of the Lodestar powerplant controls, hydraulic, fuel, oil, antiice and electrical systems with those of the Learstar.

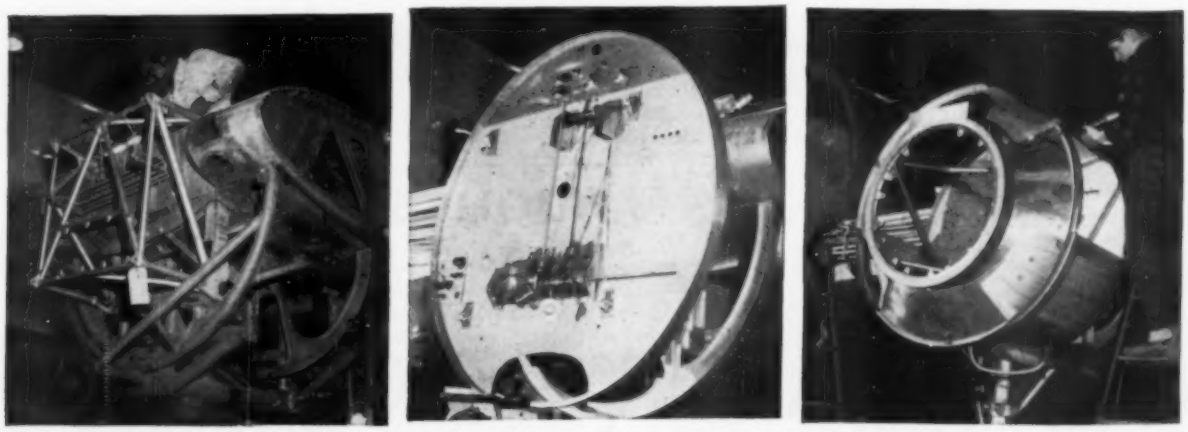
Pending complete data reduction for conformance with CAR Part 4B requirements for its transport category type certificate, the delivered Mk. 2 conversion belonging to Plymouth Oil is limited to 19,500 lb. gross weight. Completion of data reduction in the single-engine climb performance regime will yield certification for an all-up gross weight of 22,500 lb., 1,500 lb. less than the Mk. 1 Learstar conversion. Lear is guaranteeing the 22,500 lb. gross weight figure to all Mk. 2 purchasers, including Warren Oil Co., Tulsa, Okla., which has or-



PLYMOUTH OIL CO. Learstar Mk. 2 delivered by Lear 90 days after rework started.

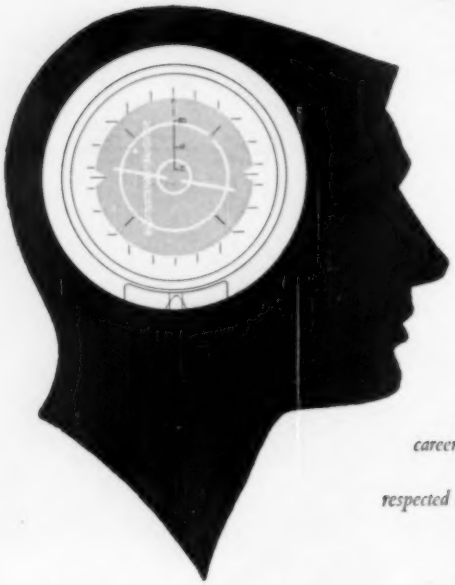


MK. 2 CUTAWAY showing cabin interior. Nacelles have new cowling, engine mounts.



NACELLE AREA (left) with precision jig attached for building up Learstar nacelle. Basic nacelle structure has been completed and Learstar fire wall mounted (center). Nacelle with engine mount, stainless steel engine diaphram installed (right).

Systems Career: a laboratory for learning



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Flush antennas: a creative challenge for Boeing engineers

The translucent "window" slightly above and to the right of the man's head is a plastic and glass fiber insulator which electrically isolates the fin tip from the rest of the airplane's structure. This permits the tip to be used as an antenna—one of more than 50 on the Boeing B-52. Many of these antennas take structural loads, and they must function perfectly through extremities of stress, vibration and temperature change.

In this and other flush antenna projects for airplanes and guided missiles, mechanical and civil engineers investigate new materials and ways of using them, and devise structures and components to withstand the extreme conditions of high-speed flight. Electrical engineers and avionics specialists develop antennas whose electrical properties remain constant in unfriendly physical environments. Aeronautical engineers make certain that these antennas preserve the aerodynamic integrity of the aircraft.

Flush antennas will become increasingly important as planes and missiles enter the hypersonic region. They are just one example of how, at Boeing, engineers find challenging and creative work, and a chance to be leaders in the growth of the engineering art. Because of Boeing's steady expansion, the number of engineers employed by the firm has actually quadrupled during the past ten years. And more engineers are needed for research, design and production on the B-52, the 707 jet transport, the KC-135 jet tanker, the BOMARC IM-99 pilotless interceptor, and on other projects which cannot yet be announced.

Engineers who join Boeing will find, in small and tightly knit project teams, individual recognition and opportunity for professional growth. They will be able to pursue advanced studies with all tuition costs paid by the company, and participate in a liberal retirement plan. There may be an opportunity for *you* to work with outstanding men in many fields at Boeing. Why not find out today?

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Boeing Airplane Co., Dept. C-55, Seattle 24, Wash.

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Boeing Airplane Co., Dept. C-55, Wichita, Kansas

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dered the second Mk. 2 conversion.

In certificating the Mk. 2 airplane, CAA accepted the flight characteristics of the Mk. 1 aircraft, and demanded a minimum in performance flight testing due to the differences in powerplant.

The Mk. 1 has 1,425 hp. available for takeoff, and is rated at 1,275 METO power. The Mk. 2 has 1,325 hp. available for takeoff and a METO power rating of 1,200 hp.

The Mk. 2 carries less fuel than the Mk. 1 and is lighter. The Mk. 2 gross weight is 24,000 lb., has slightly smaller payload, and slightly less range (see table) yet is substantially above the Lodestar in equivalent performance areas.

Variations in rework necessary for Lodestar conversion to Learstar Mk. 2 include the landing gear, with a fair percentage of Lodestars now in executive operation incorporating a Lear kit changing the wheels to a Convair type and brakes to single-spot in place of the old multiple disk brakes.

Another provision to be made for Mk. 2 conversions is an outer wing panel exchange system, wherein old Lodestar wings are exchanged for a set of panels already modified to Learstar airfoil and integral tankage specifications, providing the old set can be modified to the Learstar spec. The system will help reduce the airplane down-time for conversion. Presently, a door-to-door time of 90 days for Lodestar to Learstar Mk. 2 conversion time is quoted in all contracts. Although the Plymouth Oil plane had its own outer panels reworked, it still was just 90 days down in the rework system.

Actual changes Learstar Mk. 2 conversion include:

• **Outer wings.** New structure and airfoil forward of spar; new high-speed, high-pressure de-icers with Bendix Eclipse-Pioneer control system; fibrous-glass wingtips and new navigation lights; Safeflight stall warning system; fuel, oil, mechanical and electrical system rework.

• **Nacelles.** New cowling, engine mounts and Dynafocals for any model Wright R1820 engine (recommended for this conversion are the R1820-56A or -72A); new stainless steel dishpan, exhaust stacks and trough, and firewall; new cowl flap, oil coolers and carburetor heater systems; accessory cowlings, nacelle structure and fairings; wheel-well doors and mechanisms; new wheels and brakes (where needed); new fire detection and extinguishing system and firewall shutoff valves; auto-feathering system; rework of fuel, oil, hydraulic and mechanical systems.

• **Nose section.** New nose cone with horizontal pitot masts and flush-mounted taxi lights; Janitrol 100,000 Btu. heater installed in No. 1 baggage compartment. Optional at extra cost are Lear radome and installation of weather radar system.

• **Empennage.** Angle of incidence changed; structural beefup; retractable tailwheel, fibrous-glass tail cone and saddle fairing; rudder and elevator spring tabs; fibrous-glass stabilizer tips; electrical and mechanical systems rework.

• **Antennas.** Omni whiskers on vertical fin; flush-mounted glide path; flush-mounted marker beacon; ADF loops under saddle or flush-mounted Bendix; ADF sensing, whips under belly or forward of windshield—Lear broadband under belly or through the saddle; rework existing radio configuration to Mk. 2 specifications.

• **Flaps.** Remove bat wings and external flap tracks; extension and feathering of flap and wing trailing edges.

Lear says negotiations have been in progress for some time with a number of companies regarding the Mk. 2 conversion. Several more firm contracts are expected when CAA issues the type certificate, due about the middle of September. The Plymouth Oil airplane is operating temporarily under a supplemental type certificate.

Currently there are 16 Mk. 1 Learstars and one Mk. 2 in operation.

LODESTAR-LEARSTAR COMPARISON*

	Lodestar	Learstar Mk. 2	Learstar Mk. 1
Gross weight	19,500 lb.	22,500 lb.	24,000 lb.
Basic weight	14,300 lb.	14,900 lb.	15,700 lb.
Pay load	5,200 lb.	7,600 lb.	8,300 lb.
Ten passengers; including crew	2,000 lb.	2,000 lb.	2,000 lb.
Available fuel load	3,200 lb.	5,600 lb.	6,300 lb.
Fuel (gal.)	533.3	933.3	1,050
Flying time at 108 gal./hr	4.9 hr.	8.6 hr.	9.7 hr.
Airspeed (same power)	220 mph.	272 mph.	275 mph.
Range to dry tanks	1,078 mi.	2,339 mi.	2,667 mi.
Range plus one hour	858 mi.	2,067 mi.	2,392 mi.
Maximum range to dry tanks (standard cruise)	1,298 mi.	2,828 mi.	3,437 mi.
Maximum flying time (cruise 108 gal./hr.)	5.9 hr.	10.4 hr.	12.5 hr.

*Lodestar data is based on performance and specifications of Plymouth Oil Co. airplane before conversion to Learstar Mk. 2; current performance is shown in column 2. Source: Lear Aircraft Engineering Division, Lear, Inc.

LEARSTAR MK. 2

Sample Cruising Speeds (TAS at 10,000 ft.):

Maximum recommended cruise, 840 hp./eng. (70% METO power)	290 mph.
Normal cruise, 700 hp./eng. (58½% METO power)	272 mph.
Long-range cruise, 540 hp./eng. (45% METO power)	240 mph.
Climb Rates (sea level):	
Two-engine, en route	1,250 fpm.
One-engine, en route	400 fpm.

LEARSTAR nose cone with pitot masts, bell mouth for admitting ventilating air.

CLOSEUP of port flap bay showing details of shortened flap tracks.

THEY CAN RUN... BUT THEY CAN'T HIDE!

The "bogeys" never had it so bad. Successful infiltration of our skies by their manned aircraft is slimming away to the point of no return—thanks to Navy F4D Skyray fleet interceptors.

The sleek, supersonic Skyray has a new stinger—Westinghouse Aero 13 armament control system. Aero 13 employs search-track radar to find the target. The computer calculates the best attack course and firing information. The rest is wreckage! Weather and moonless night make no difference. The "bogeys" can run, but they can't hide.

The Aero 13 armament control system is another example of Westinghouse creative engineering to solve today's problems—and tomorrow's applications, as well. Information and engineering assistance in specific fields of airborne electronic systems are available to you from Westinghouse Electric Corporation, Air Arm Division, Friendship International Airport, Baltimore 27, Maryland. J-91050

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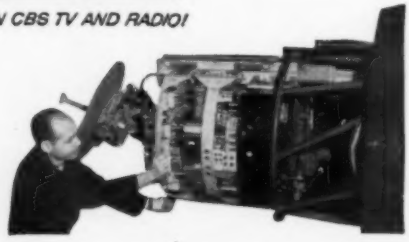

Unique barrel-type package fits perfectly in the nose of the aircraft. Overhead slide-rail mounting provides easy pull-out for service.

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Lightplane Autopilot Makes Debut in Fall

A new lightweight three-axis autopilot for light business and personal planes will reach dealer's shelves this fall and is scheduled to go into quantity production early next year. Weighing 8.5 lb., the equipment operates on pneumatic principles, uses no motors or electronic tubes (AW Jan. 23, p. 67).

One of the features of the autopilot is a heading lock. The equipment has been undergoing development for three years and has been flying on Beech Bonanzas for two years. It will be demonstrated for the first time publicly in September.

Builder is Tactair, Inc., a division of Aircraft Products Co., Bridgeport, Pa., which manufactures military aircraft hydraulic and pneumatic equipment. The unit was designed by William Harcum, a former Sperry engineer. Tactair has named R. B. (Buck) Springer sales manager for its autopilot.

Fiat Will Build Light Amphibians

Four prototypes of the four-place Nardi F.N. 333 pusher utility amphibian will be built by Fiat to speed development of the project. The planes will undergo acceptance trials to pass Registro Aeronautico Italiano and U. S. Civil Aeronautics Administration type certificate requirements.

Nardi plans a demonstration tour of the F.N. 333 in the Western Hemisphere this year, including extensive coverage of the U. S. (AW July 30, p. 92). The Nardi is powered by a 240-hp. Continental 0470-H engine turning a constant-speed Hartzell propeller. It has a gross weight of 2,970 lb., weighs 1,848 lb. empty. Top speed is approximately 180 mph. and maximum range is about 870 mi.

U. S. BUSINESS & UTILITY AIRCRAFT SHIPMENTS

January—July 1956

Make and Model	Aircraft		Builder's Net Billing Price	
	July	Jan.-June Total	July	Jan.-June Total
Aero Design 560-A	4	32	$1,188,000	$4,596,700
680	14	30		
Beech Bonanza	35	466		
Super 18	10	53		
D18S	0	6	2,589,200	15,474,168
Twin-Bonanza	15	67		
Model 45 Trainer	0	50		
Callair A-4	2	11	11,108	49,612
Camair 480 Twin-Navion	0	11	0	293,450
Cessna 170	5	65		
172	105	854		
180	22	341	3,063,581	[1] 20,876,566.35
182	113	485		
310	16	124		
Champion 7EC	19	97	76,350	375,278.46
Helio H-391B Courier	3		69,000	
Lear Learstar Mk. 1	0	3	0	1,840,000
Learstar Mk. 2	0			
Mooney M18C	2	7	68,733	343,873.65
M20	6	32		
Piper Super Cub PA-18	19	111		
Super Cub PA-18A	19	286	1,088,295.25 [2]	12,159,369.84
Tri-Pacer PA-22	53	658		
Apache PA-23	21	219		
Royal Gull P-136L1	2	8	74,500	596,500
Taylorcraft Model 20	4	19	39,800	160,153.80
Totals	489	4,035	$8,268,567.25	$56,765,672.10

[1] Includes sales of five factory-owned Model 195s and two agricultural versions of L-19.
[2] Piper deliveries down over preceding months due to two-weeks plant shutdown for annual plantwide vacations.
Source: Compiled by AVIATION WEEK. Previous tabulations for 1956: AW Aug. 27, p. 81; AW July 9, p. 84; AW May 28, p. 10; AW May 7, p. 103; AW Apr. 2, p. 67; AW Mar. 19, p. 63.

PRIVATE LINES

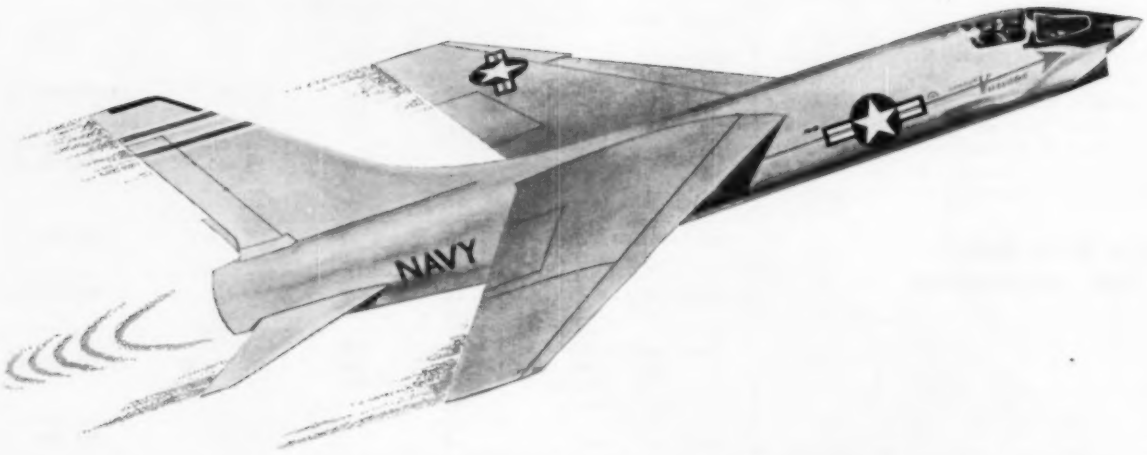
Qualified aircraft and engine mechanics can apply for Civil Aeronautics Administration's new Aircraft Inspection authorization, granting them additional authority to conduct and approve periodic and progressive airframe and powerplant inspections and to approve major repairs and alterations. Instructions for applying for new authorization are in Civil Aeronautics Manual 24 obtainable from Government Printing Office, Washington 25, D.C.

Lear, Inc., program of developing a nationwide network of approximately 100 factory and CAA-certified dis-

Italians Produce Fast Lightplane

This two-place side-by-side Partenavia P.55 Tornado lightplane has a top speed of approximately 155 mph. Powerplant is a 140-hp. Lycoming 0290-D2 and a fixed-pitch propeller is used. Construction is all-wood. Gross weight is approximately 1,475 lb., weight empty about 970 lb. Exhaust augmentor system is fitted to engine to aid powerplant cooling.

NAVY SETS SPEED RECORD WITH VOUGHT CRUSADER!



F8U-1 Streaks over Thompson Trophy course at

1015.428 mph!

A standard production model Chance Vought F8U-1 Crusader — averaging a blazing 1,015.428 miles an hour — has set a U. S. speed record and captured the coveted Thompson Trophy for the Navy in that service's first entry in this historic aviation event.

The former official record, set last year, was 822 miles an hour.

Commander Duke Windsor, USN, crack Navy test pilot, streaked over California's Mojave Desert at an altitude of 40,000 feet in setting the record. He made two runs over a precisely measured 15.1 kilometer (9.3 miles) course, trailing a sonic boom across the desert in his wake.

Significantly, the triumph was achieved with a stock, combat fighter, identical with Crusaders soon to be delivered to the U. S. Fleet. It carried a full complement of cannon, and ballast equal to a full ammunition load.

The Crusader's U. S. record — first to top 1,000 miles an hour — marked the third time Chance Vought-designed aircraft have captured the Thompson Trophy. Commander Cook Cleland, USNR, flying as a civilian, piloted Corsair fighters to new records in 1947 and 1949.

THOMPSON TROPHY EVENT

The Thompson Trophy, traditional symbol of speed, has been awarded annually since 1929.

Originally, the trophy event involved a race around pylons with high performance piston-engine aircraft, but its character gradually changed with the advent of jets.

Today's supersonic speeds have ruled out closed course racing. A straightaway race against time has taken its place.

The first jet race was held in 1946, with the winning plane recording 516 miles an hour.

Now, ten years later, Chance Vought's Crusader — first plane ever entered in the event by the Navy — nearly doubled that speed when it became the first trophy winner to exceed 1,000 miles an hour.

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tributor radio, autopilot and navigation equipment service centers is well underway with about one quarter of its representatives' installations approved.

Metal wing conversion for Ercoupe Model 415 developed by Skycraft Design, Langhorne, Pa., is approved by Civil Aeronautics Administration under supplementary type certificate SA1-4. The firm has converted more than 60 sets of Ercoupe wings thus far, expects to double present output of two sets weekly soon.

Bendix Polar Path compass will be used by a Fairchild Aerial Surveys converted Beech AT-11, which will do a magnetometer survey over approximately 10,000 mi. of uncharted south Peru jungle searching for oil deposits.

Transistorized speaker amplifier, Model CA-3, provides 7.5 watt output, 25-db. gain. Measuring 2¼-in. wide x 2¾-in. high x 5¼-in. long, the unit weighs 1 lb. 9 oz. It is the first of a line of transistorized aircraft electronics equipment being developed by Flite-Tronics, Inc., Burbank, Calif.

Lang Aircraft Supplies, Omaha, Neb., is new factory distributor and service station for Lear, Inc.

Preview of Civil Cessna Helicopter

Interior of civil version of Cessna CH-1A helicopter, soon to go into production, is previewed in this dressed-up prototype. Initial deliveries of the four-place commercial model will be made in 1958 soon after CH-1s are provided to the U. S. Army, which has ordered an evaluation quantity.

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WHO'S WHERE

(Continued from page 23)

Mark A. Starr, director-material, Missile Development Division, North American Aviation, Inc., Los Angeles, Calif. Also: **C. R. Raftery**, director-material, and **Joseph A. Geisler**, assistant factory manager, of North American's Autonetics division.

T. E. Morgan, assistant regional superintendent-maintenance (Chicago), Trans World Airlines.

Dr. Herbert C. Corben is now a member of the Electronic Research Laboratory staff of Ramo-Wooldridge Corp., Los Angeles, Calif. Dr. Corben was professor of physics at Carnegie Institute of Technology.

Ben Butterfield, public relations staff, American Airlines.

John E. Lowe, director-personnel and public relations, American Machine & Foundry Company's new guided missile launching system plant, Rochester, N. Y.

Z. W. Pique, marketing manager, Semiconductor-Components Division, Texas Instruments, Inc., Dallas, Tex. He replaces assistant vice president J. P. Rodgers, Jr., who has resigned. **Jay R. Reese** replaces Mr. Pique as field sales manager.

Leland B. Cameron, purchasing and stores department manager, Hiller Helicopters, Palo Alto, Calif.

Charles E. Smith, manager-air mail, and **William H. Nelson**, supervisor-tariffs, Braniff Airways.

Paul J. Chaney, commercial products sales manager, Metals Processing Division, Curtiss-Wright Corp., Buffalo, N. Y.

B. K. Moores, director-industrial marketing, Lehigh Chemical Corp., Chestertown, Md.

H. Thomas Larkins, Eastern sales manager, Clifton Precision Products Co., Inc., Clifton Heights, Pa.

Norman L. Harvey, operations manager-tubes, Electronics Division of Sylvania Electric Products, Inc., Woburn, Mass.

Percey A. McReddie, sales staff (New York), Canadian Pacific Air Lines, Ltd.

Richard M. Ervin, Washington, D. C., office manager, Hyster Co., Portland, Oreg.

Melville E. Ingalls, district manager-sales, Nickel Cadmium Battery Corp., Easthampton, Mass.

Harry W. Kohl, division engineer of the newly created Bay area project division (San Jose), Missile Systems Division, Lockheed Aircraft Corp., Van Nuys, Calif.

Robert Booth, manager-Republic of Panama, Braniff International Airways. He succeeds **Melvin Doolittle** who will transfer to Buenos Aires as manager-Argentina.

Robert W. Boesel, chief project engineer, Guided Missiles Division, Republic Aviation Corp., Farmingdale, N. Y.

T. C. Erickson, industrial relations director, Servomechanisms, Inc., Westbury, N. Y.

Raul H. Frye, general manager, Electronics Division, Fairchild Camera and Instrument Corp., Syosset, N. Y.

George Leland, Southwest district manager, Aviation Products Division, Fenwal, Inc., Ashland, Mass.

Dr. George Gerard, research professor of aeronautical engineering, and **Dr. Johann Ludloff**, professor of aeronautical engineering, New York University, N. Y.

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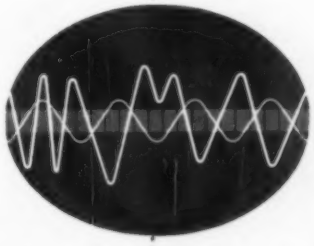

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These are among the test data evaluation, processing and reduction activities at R-W for the Air Force Intercontinental and Intermediate Range Ballistic Missiles.

This test evaluation program is an important aspect of R-W's technical direction responsibility for ICBM and IRBM.

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Please address inquiries to: **Mr. W. J. Coster**

The Ramo-Wooldridge Corporation
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AVIATION WEEK

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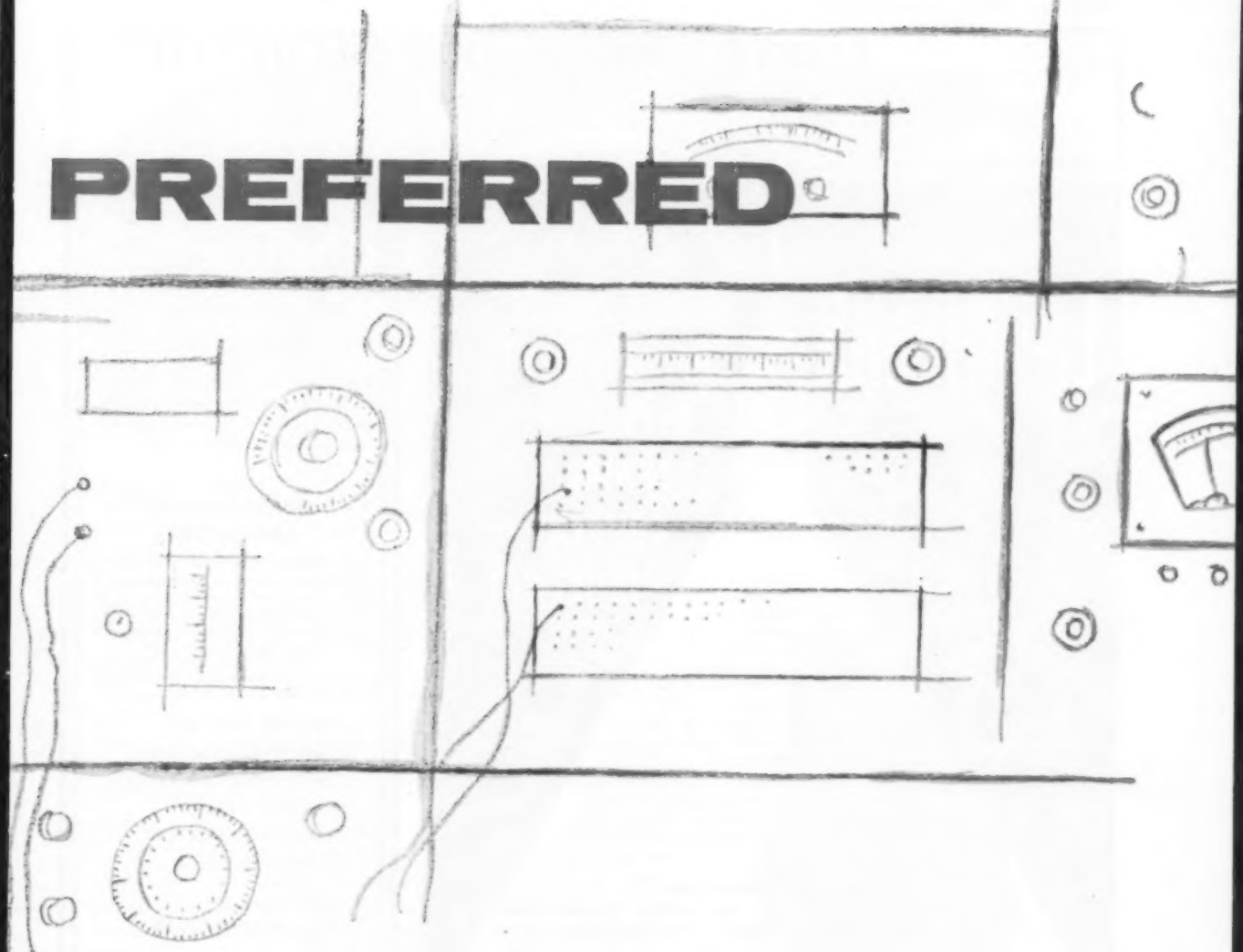

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AC
The Electronics Div.
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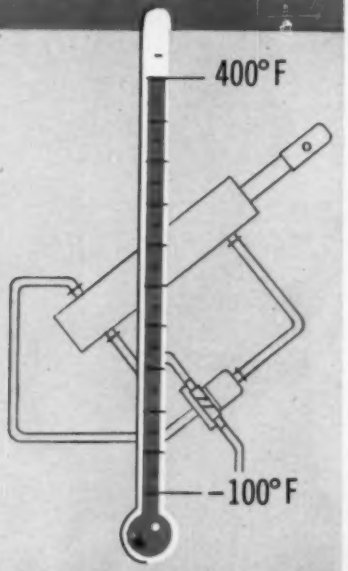

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Bendix-Pacific is one of the largest and best equipped sources for hydraulics in the nation. You are sincerely invited to consider joining this forward looking company where you can enjoy all the advantages of Southern California living.

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Outstanding Opportunities Available

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Engineers

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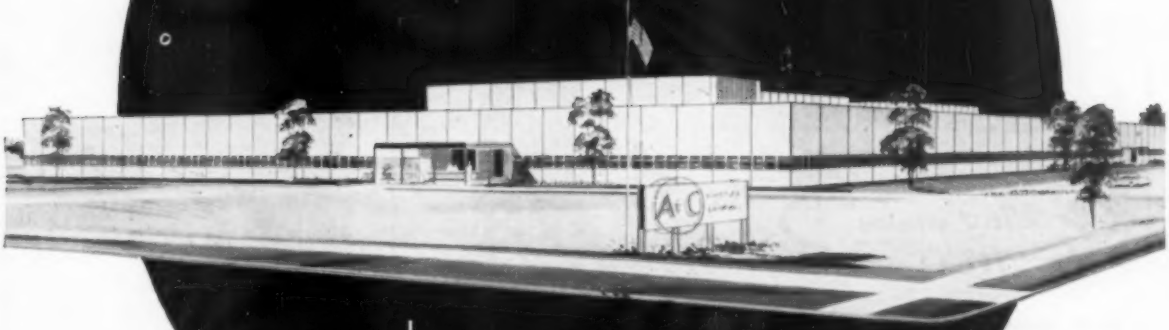
G M's long-standing policy of decentralization creates unlimited opportunities for qualified Electrical, Mechanical Engineers and Engineering Technicians.



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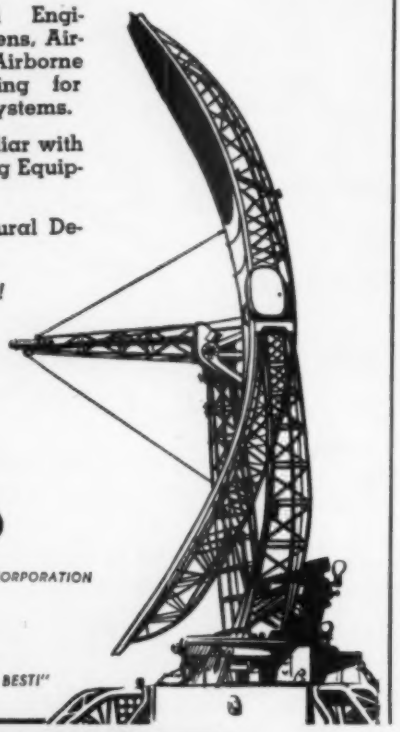
Vice President and Director of Engineering
Dept. T-8



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Write to us

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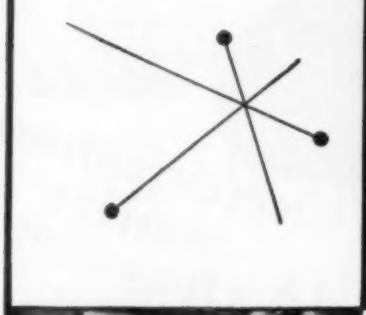

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FIRST *such system ordered into quantity production. (The Bank of America to convert to ERMA.)*

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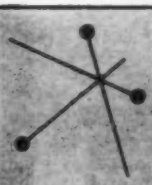

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ENGINEERS

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GM INERTIAL GUIDANCE SYSTEM PROGRAM ELECTRONICS DIV.,

Milwaukee 2, Wis.

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GM

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- Electronics Package Cooling

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To aid you in your professional advancement AC will provide financial assistance toward your Master's degree. A Graduate Program is available evenings at the University of Wisconsin, Milwaukee.

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To arrange personal, confidential interview in your locality send full facts about yourself today to

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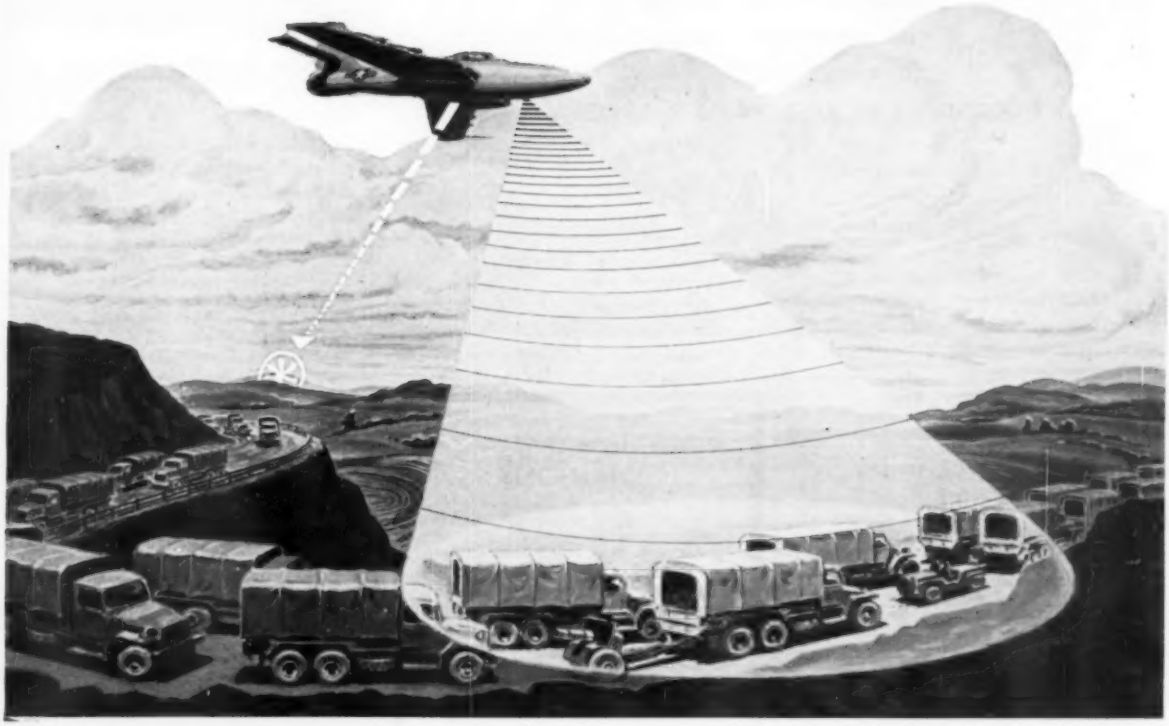

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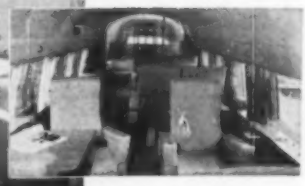

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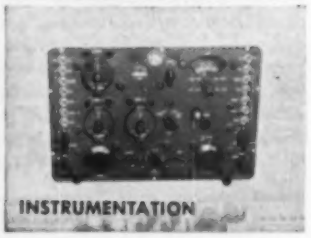

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LETTERS

Autobomber

Some recent reports from the Kremlin indicate that the Russians may be ahead of the U. S. in the race to develop Intercontinental ballistic missiles—a race which will further augment the atomic deadlock. Since this race is progressing rather rapidly, there are some ICBM enthusiasts who believe that further development of a Snark-type missile is a waste of time and money. This is a point on which I will agree for a one-way Snark-type missile; however, a round-trip version, i.e. an autobomber, could be very versatile. If it were a nuclear powered autobomber equipped with supply pods for guerrilla warfare and with provisions to replace the supply pods with atomic or thermo-nuclear bombs, it would be a "bigger bang for a buck" with "instant and massive retaliation" capabilities.

The preliminary design department of Northrop Aircraft, Inc. had a round trip version of the Snark on its drawing boards in 1953. It had the engine in the fuselage, like the Snark SM-62, and supply pods under the wing. It had an intercontinental, round-trip range with one engine instead of eight, as in the B-52 bomber, and it was slightly faster than the B-52. Why the Defense Department and the Company didn't push this autobomber project instead of the Snark SM-62 is a mystery. Perhaps it is due to a much greater shortage of economists than engineers.

LeRoy F. Iverson
3524 Elm Ave.
Manhattan Beach, Calif.

Engineering Managers

I have read with interest the letters on the shortage, lack of shortage, use and misuse of engineers for the past two months. As an expression of opinion I attribute this situation to the "engineering managers" in the field of research and development. They hold these top positions entirely due to their reputations earned in traditional engineering activities and the fact that their firms are best equipped to bid on research activities or find it necessary to engage in them to support their own product development. These misguided individuals attempt to fill every research position with an engineer. But if we examine engineering curricula, it becomes apparent that few categories of college graduates are better prepared to apply time tested methods and rules of thumb and more poorly prepared to apply scientific methodology to research problems than is the engineering graduate. Two exceptions to this generalization can be made. In a few of the better schools, graduate engineers in electronics and aerodynamics are required to be more than the traditional handbook engineer.

When many of the problems that require the bulk of our research expenditure are examined—nuclear energy, geophysics, vibration, reliability, heat and radiation, etc.—it becomes apparent that physicist, mathematicians, chemists, physio-chemists, statisticians and even biologists are much better equipped both in theoretical background and methodology to attack these problems or at least segments of these problems than is the ordinary B. E. Many people with Masters and Doctors degrees are available at a fraction of engineering salaries, but nonetheless the Chief Mug-wug is an engineer and must fill all positions with members of the same tribe.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Earl A. Thomas
Winchester, Mass.

Cockpit Visibility

It was with a great deal of interest that I read Major Wade's excellent letter regarding "Cockpit Visibility" (AW Aug. 13, p. 102). An important aspect, indeed, is the ability to see and be seen, since to my knowledge the majority of flying is still done under VFR conditions.

By this I mean that most flying still depends upon outside vision—the ability to see around you and be seen regardless of how you file.

Many of us seem to feel that filing IFR means an assigned route, altitude and timing —free and clear of other aircraft in spite of conditions. In weather, this should be and I am reasonably convinced that it is, but in VFR weather it definitely is not and I see no immediate reason for it being so. Closing speeds are not *that* fast. I often wonder about the reported "near miss." In some cases I feel sure that the reporter of the "near miss" is suddenly confronted with other aircraft whose crew has been watching him throughout the closure. When attention is momentarily diverted, the sudden realization that another aircraft is passing might well result in a frantic decision of "near miss" when, in fact, it would have a normal passing had he been aware of the approach and passing course of the other aircraft.

CAA communications broadcast reminder is a good one to heed—"Keep alert, watch for other traffic."

As Major Wade relates, to his knowledge all airline vs airline collisions to date have occurred between aircraft flying nearly parallel courses. The converging courses vertically rather than laterally are the dangerous ones. I am sure every pilot is aware of the blind areas behind, above and below him.

Captain Kriloff of United Airlines has expressed in a letter to the editor (AW July 30, p. 102) that 100% IFR can remedy the potential collision situation. ATC is not operating exclusively for the airlines. The facilities, manpower and air space required would be fantastic, to put it mildly. All the rules of the road in the world are not going to eliminate the need for continuous outside visual surveillance.

In this writer's opinion, the most effective way to minimize the collision hazard is to increase the pilot's cockpit visibility and his vigilance. A man who has flown in combat knows the importance of continuous visual scanning or he probably is not here to worry about it.

Aviation Week editorial "We Are All to Blame" was a commendable one, but we are not all to blame in just the category related in the editorial. We accept a new airplane with all the latest instrumentation and automation, but disregard the still major asset—vision. Most of us prefer to be fashionable and blame CAA, CAB, ATC or the lack of appropriation to support them.

The amazing thing about this situation is that in terms of engineering effort expended on aircraft today, it would take but a fraction of this effort to accomplish realistic cockpit visibility.

As Captain Kriloff says, "It's as simple as that." Actually, that's not simple, but a whale of a lot simpler than 100% IFR, and I honestly feel, just as effective.

C. H. Sperry
Rodney Hunt Machine Co.
Orange, Mass.

Irked By Co-Pilot

Your July 30, 1956 issue contained a letter by a United Flight Officer concerning the pilot solution. In certain respects it not only made me laugh, but also hurt the pride and love I have for my career.

I have spent 10 years in aviation and I am 27 years old. Please bear in mind I am fully aware of and appreciate the skill, know-how and requirements that a pilot must have. The greatest portion of my 10 years in aviation has been devoted to mechanics and flight engineering. Flight engineering is my career and I worked very hard for years to acquire the necessary knowledge and background which I believe flight engineers should have.

Let's all remember that in 17 weeks of training to receive an instrument rating, and a flight engineers rating, plus learning company procedures is a lot of learning in so short a period of time.

This United Flight Officer in his comments has made, in my opinion, a mockery of the flight engineers job. He hasn't used flight engineering as it's to be used, and has abused all that flight engineering stands for in his advancement to the right hand seat.

It's an easy way to move to piloting if he wants to do it that way, but he is stepping on a lot of flight engineers who respect and think a lot of their career. Flight engineering was not meant for that purpose in the beginning, but evidently here is a person who thinks so.

I am very happy that he will be in that pilot's seat soon for he has shown that flight enginering was just another bridge to cross to get to his piloting goal. I would feel a lot safer flying on an airplane with him as a pilot than as a flight engineer because the flight engineers job hasn't even begun to rub off on a yearling.

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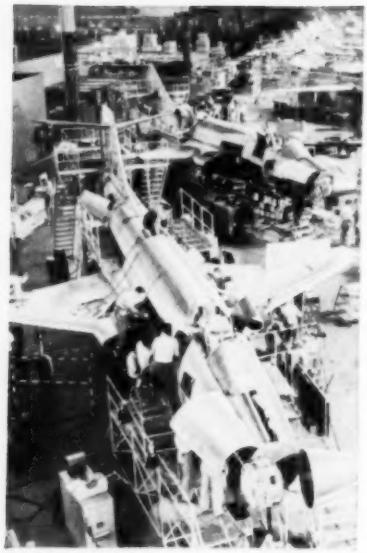

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